THE

ELECTRICAL REVIEW.

VOL. LVIII. MAY 4, 1906. No. 1,484.

ELECTRICAL REVIEW.

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THE

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1906 Edition

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LESSONS FROM THE SCRAP HEAP.

IN every modern business there are many departments, but in many there are one too few. All have a scrap heap of some kind, but not all recognise it as anything more than just a heap, although there may be much to learn and much to save from its teachings.

First of all a scrap heap should be organised; it should not be just a promiscuous collection of the detritus of the establishment, everything hugger-mugger and indistinguishable; but the waste of each material should be kept separate from the rest, and it may be helpful to sort out some of the various forms which certain materials take.

In this manner not only will a better market be found for the scrap, as the dealers know exactly for what they are quoting, and have to allow the minimum for sorting and handling, while there is less opening for fraud, but the officials of every department and the manager of all have an ever present opportunity to check needless waste, and to get ideas for improved designs by observing where the old have failed, or where they can be lightened with nothing but advantage. Often such ideas will strike a man who sees a number of similar articles together, when one or two seen before they go to the scrap heap will not produce any impression.

Especially is inspection valuable as a means to discover whether material is being given its full life, and to a lesser degree, whether it is being kept at work too long.

Consider, for instance, the scrap heap of a tramway depôt. There the bins may be labelled cast-iron for brake-blocks, chilled wheels, gear cases and so on; wrought-iron for the waste of the smiths' shop, for cast-off brake gear and the like; cast-steel for gear-wheels; wrought-steel, perhaps with cast-steel or in a bin by itself; other divisions for light steel and cast or wrought-iron, steel wire and other light material; and still others for the waste of the machine tools. Copper, in the form of old commutator segments, turnings, stripped cable, controller fingers, trolley wire and bonds; gun-metal, as bearings, axle keeps, overhead ears and other fittings; white metal, lead, lamp tops, and rubber, all being easily removed without authority, should be kept separately under lock and key.

Something is gained even if method stops here, but the greatest profit is derived by the engineer who takes the trouble to turn over a few of the brake-blocks occasionally, to see what the men who change them consider to be their life, and to get some idea of the care with which those men adjust the blocks so that they shall wear evenly; who considers the teeth of the gear and pinion wheels; who compares the wear at the flange of a bearing with the wear of the shell; who contemplates the better design and further repair of gear cases, after observing the reason for so many being scrapped; who rouses up the foreman for turning out his wheels too soon.

Indeed, the hours spent in just looking at the scrap heap are likely to be of greater value than many a day passed in the office.

Electrical Omnibus Manœuvres.

The extraordinary action of the London Electrobus Co. in proceeding to allotment the day after the lists were opened has naturally aroused much adverse comment; the directors took no pains to disguise the fact that they were alarmed by the storm of criticism which commenced in the daily Press on that day, and fearing that many would withdraw their applications in consequence thereof, they hastened to forestall them by rushing to allotment. Such a proceeding can only be described as trickery. The legality of their action has been questioned, and we understand that the aid of the law is to be invoked to relieve the unfortunate and misguided individuals who have thus been entrapped. It is stated that, apart from the premature allotment, the prospectus contains misrepresentations amply sufficient to secure relief, provided that it is sought without delay: shareholders who are dissatisfied should, therefore, lose no time in lodging their claims.

Some of the views put forward for and against the scheme, and gravely commented on in the lay Press, are ludicrous; others are hopelessly mistaken. For example, one "expert" thought that the electrobus would suffer less wear and tear owing to the entire absence of vibration when it was stopped! Is the electrobus to spend its time at a standstill to avoid vibration? In another instance, the cost per mile for "current" supplied to electric carriages by the Metropolitan Electric Supply Co. is stated by Mr. E. Cunliffe Owen, the secretary, to average 1¼d., while the maintenance of the battery at 25 per cent. per annum on a mileage of 4,000 to 5,000 a year is given as not more than ½d. per mile. Really, this is too absurd. What comparison is there between the running costs of an electric brougham and those of an omnibus for public service? Even assuming that the two things were comparable, Mr. Owen's statement at once puts the cost of energy alone per mile for a 6½-ton vehicle at least at 3¾d. per mile; and what battery will last *four years?*

In an anonymous article in a contemporary, presumably written by one of our correspondents in this issue, we are accused of having "notoriously belittled all forms of electric traction which is *(sic)* not expressed in tramcars." We have not done so; on the contrary, we have devoted much space to electromobile matters. We have, however, invariably opposed all efforts to float wild-cat schemes on the strength of the magic word "electric," such as the foregoing, and we shall continue to do so, with a single eye to the best interests of the electrical industries.

Elsewhere in this issue we refer to another omnibus project depending upon the use of electricity. Technically speaking, the system is admirable. We have not seen the actual vehicle, because at present there is none in this country, but we are content to accept Mr. Worby Beaumont's verdict on its capabilities. Commercially, however, the question assumes a totally different aspect, upon which Mr. Beaumont is discreetly silent. There is only one satisfactory way of answering this question; that is, to run the vehicle under commercial conditions for at least a twelvemonth, and to prove beyond doubt that the running and maintenance costs are low enough to ensure an adequate return on the capital expenditure.

Electrolysis of Pipes.

Mr. E. E. Brownell, who is an expert on this subject, furnishes much new and interesting information in a paper read before the American Institute of Electrical Engineers. Where electrical railways or tramways are numerous in large American cities, the corrosion of the gas and water pipes by the return earth currents is becoming, with the lapse of time, very serious. It has been proved by experience that a current flow of 1 ampere passing from the unprotected surface of an iron structure will remove about 20 lb. of metal per year from it, or about 72 lb. if the structure is lead. It has often been erroneously stated that a difference of potential of 1·5 volts between pipe and earth is necessary to produce electrolytic corrosion upon pipes, but Mr. Brownell has found a potential difference of 0·2 volt quite sufficient to effect the destruction of miles of piping. The use of salt to liquefy snow on electric lines is to be avoided, as it increases the electrolytic corrosion.

Cast-iron, when corroded by electrolysis, leaves a residual which has no tensile strength, but often deceives the observer into the belief that there is no deterioration. Other things being equal, cast-iron will stand a less amount of deterioration than wrought-iron or steel.

Insulated pipe joints are severely condemned, for, as is well known, they shunt the current round the joint, and lead to corrosion at every joint, instead of localising it at the place where the current leaves the system near the station. It is recommended, indeed, to make the pipe joints as good conductors as possible by avoiding caulking and by using screw joints.

The steel buildings so common in the United States run a great risk of destruction by electrolysis. The author knows of one building where electrolysis has attacked the sub-steel work, and if this continues long enough it may lead to a great disaster.

Mr. Brownell says that it is a common fallacy to believe that alternating currents do not cause electrolytic corrosion. He has proved by experiment that the deterioration is quite marked. Corrosion by alternating currents is more objectionable than corrosion by direct current, because it is distributed over the whole pipe system instead of being localised in a known place.

As to remedies, the author of the paper considers that the only perfect remedy is the insulated return, either in the form of the double trolley or otherwise. But the cost of carrying out this system except in the most populous towns he considers prohibitive. Various devices are available, however, which may mitigate the evil. Among these are mentioned with approval the "7-volt British Board of Trade rule." But this system would add greatly to the cost of electrical lines as at present constructed and worked in the United States. The best remedy, next to the insulated return, is to make all sub-surface metallic structures negative to the earth. The working of this remedy requires good rail bonding and other precautions, but where there are complicated distributions of current it may be impossible to carry it out. Another remedy, of a rather problematic character, is mentioned in the article on the Long Island City Power Station elsewhere in this issue.

Who shall maintain the Track?

Some little stir is observed in municipal tramway circles owing to a discussion which has taken place between the Tramways Committee, the general manager, and the city surveyor of Bradford as to whether the maintenance of that part of the roadway which forms part of the tramways shall remain, as heretofore, in the hands of the surveyor, or be transferred to the general manager of the tramways.

The special sub-Committee appointed to report on the question is of the opinion that conditions have altered so much within the last few years that the change is warranted, but "that suitable arrangements should be designed whereby the authority of the street surface would be, as at present, in the hands of the surveyor, to whom the tramways department would be responsible so far as the surface was concerned." The word *authority* is ambiguous, but the Committee goes on to say that "the spending of all money should be under the control" of the manager.

The surveyor is to become a kind of consultant. Naturally enough he protests against such a slice being taken out of his duties, and the text of his report is given in a recent issue of the *Surveyor and Municipal and County Engineer*.

If there were no tramways, the authority of the surveyor over the roads would be paramount and undivided. When horse tramways came into being, the track over which the horses travelled was paved in a more substantial manner than the rest of the road, and this paving in many cases was extended beyond the rails for a little distance in order to avoid a bad joint between rails and macadam. Little question could arise over maintenance, as the tramways were mostly owned by companies, and, saving a special agreement providing for maintenance by the town, the cost was borne and the work done by the owners. Probably if the tram-

ways had been built and run by the local authorities from the first, the surveyor would have laid and repaired the track, including the rails, rather than the tramway manager, as indeed he has done in almost all cases where the local authority has built or bought the lines. It is obvious that the surveyor is the official who is most interested in the condition of the surface of the road, and that is still more so now that horse cars are defunct, for the paving between the rails is there for the convenience of the public, and not at all for the tramways, which could be worked quite as well without it.

In the horse days the surveyor had the whole road, because it was only the paving of the tramways that wanted much supervision; and in the steam and electric days it might be supposed that he would still retain the tramway paving, because it is required much more by the road users than by the tramway users. Notwithstanding the technical rights of the case, we have always been sorry that authority over the tramways should be split in any way; and, after all, the rights as we have stated them are not sound, for in fact the surface paving between rails, between tracks (generally), and for 1 ft. 6 in. outside rails has never been treated as anything but part of the tramway. Payment for it and for its maintenance is made by the tramway department, and the piper should call the tune. The surveyor, as the man who settles levels and surface conditions generally, is not to be ignored, but in matters affecting the road within the tramway he should be in the position of adviser rather than administrator, and his counsel should be sought solely on points which affect him as representing the road authority, and not as a permanent way expert, which in most instances he is not.

The matter is one with which we have not space to deal as fully as we should like, and it will arise many times in the future, but we do not think that it can be settled in a more open-minded and sensible manner than has been proposed by the Bradford Sub-committee.

We are glad to note that our traction contemporaries take the same view.

The Question of Electrical Monopolies.

THE question of the exclusive right of laying underground cables or installing overhead conductors along or across public roads is attracting some attention both in Belgium and France, as a result of endeavours made by electric lighting and tramway companies to obtain an absolute monopoly of the use of the roads to the entire exclusion of all other parties. It is submitted that the promoters of these enterprises seek to secure the insertion, in contracts made with local authorities, of a clause which is so skilfully drawn that only by the most careful examination is it possible to discover the mischief which the clause, apparently harmless at first sight, would probably produce if it were actually approved and enforced. The disadvantage of the clause does not lie in the direction of preventing the creation of competitive undertakings, but rather in the way in which it would operate against large industrial establishments, such as iron and steel works and collieries.

The point at issue may best be illustrated by recalling the fact that in France and Belgium, as in Great Britain, many collieries and iron and steel works and land owned by them are distributed over a large area which in many cases is intersected by public roads, highway and lanes, so that one part of any individual property is separated from another or others by means of public roads. As the Belgian industrial establishments of the kind in question are gradually proceeding to introduce electric lighting and power plant—and possibly also the French—it follows that the granting of an exclusive right to any promoter to use the roads in the districts concerned would have the effect of preventing the works from connecting one department with another on the other side of the road, and would also prevent supply to an extension of works on adjoining property similarly divided by a road. A case in point has just occurred in Belgium, but the Ougrée-Marihaye Iron and Steel Co. succeeded in discovering and frustrating the insertion of a clause of the kind in an agreement giving a concession for dealing with electrical applications.

The problem has also received attention in France, where the French Ironmasters' Association (the Comité des Forges) has deemed the matter to be of such importance as to lead it to circulate a copy of the law adopted by the Chamber of Deputies on February 27th, 1906, in regard to distributions of electrical energy, which is directed against the establishment of monopolies other than telegraphy and telephony. It is provided by the second clause of this Act that a system of distribution which does not need in any part of its course the use of public roads may be erected without authority on condition that it is located over 33 ft. distant in a horizontal direction from existing telegraph or telephone lines. The third clause stipulates that the use of the public roads may be had on permission being obtained from the Prefect or Mayor of the Commune, and subject to the regulations in regard to control and to payment for the use of the public way; but such sanction does not debar the granting of competitive permits for the same roads. A concession for the public distribution of energy is issued, after inquiry, either by the commune, or by a combination of communes, if the territory consists of communal property, or by the State in other cases. The concession is subject to a specification approved by the State Council, and communal concessions require the approval of the Prefect.

The new French Act further provides that one concession shall not be an obstacle to the granting of competitive powers, with the reservation that the latter shall not represent more favourable conditions than the former. An exception will only be made in the case of concessions for public and private lighting, which will be able to enjoy a monopoly of the public way without this monopoly being able to be extended to the use of energy for all other purposes, or to its accessory use for the lighting of premises in which energy is utilised in this way. It is possible for concessions to be declared of public utility by decree issued by the Council of State. Such a declaration confers upon the concessionaire the rights of expropriation on certain conditions, of erecting brackets on walls, frontages and roofs looking on the public way, and of establishing aerial conductors or underground cables across private property, &c. It will be seen that the Act, apart from the State ownership of telegraphy and telephony, gives a monopoly for lighting; but it does not prevent an industrial establishment from obtaining the consent of the local authorities to the laying of cables or of conductors, so as to connect one part of a works with another over a public road, for the supply of either light or power for its own individual use.

The Spirit of Scientific Research.

MR. R. A. HADFIELD'S James Forrest Lecture, at the Institution of Civil Engineers, had for its subject "Unsolved Problems in Metallurgy." Those portions of the address which specially interest electrical engineers are dealt with on another page. In this section we desire to give special prominence to what Mr. Hadfield has to say on the spirit in which research should be conducted. At the outset it is pointed out that there is too great a tendency to recapitulate victories, and to overlook what requires to be done. "Scientific research is not supernatural." "The ground is always ready to be broken; no field of scientific inquiry has ever been exhausted." Prejudice is deprecated, for with this quality judgment is hampered, and the senses misled. "Trustworthiness is the first aim of science, and accuracy its final aim." "It is more important to be trustworthy than to be accurate, because the former affects the fact itself, the latter only its degree or relative quality." The opinions of a number of great thinkers are referred to, and the maxims of Herschel, Cuvier, Buffon and Helvetius are quoted by Mr. Hadfield. Protracted patience and infinite attention are among the attributes required.

In order to obtain the best results, the best methods should always be applied. As a guide in the cultivation of the qualities of greatest value, Mr. Hadfield's own remarks, together with those cited by him, are both opportune and comprehensive.

D

THE EQUIPMENT OF AN AMERICAN CABLE STEAMER.

Recently we were invited by Messrs. Johnson & Phillips to inspect, at their Charlton Works, the submarine cable gear of the United States cable ship *Burnside*.

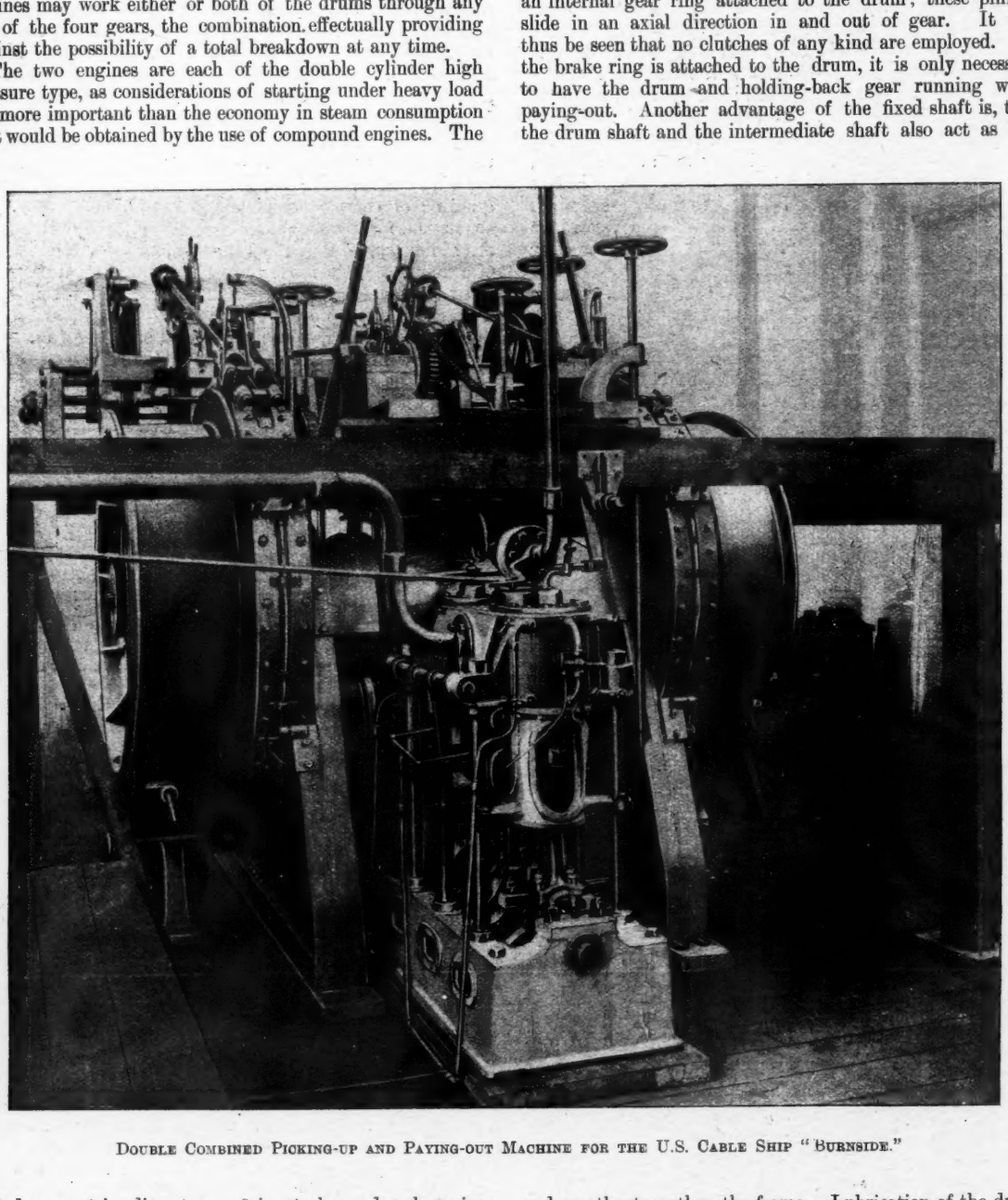
The machine is what is termed a double combined picking-up and paying-out machine, comprising practically two separate machines, arranged so that either one or both of the engines may work either or both of the drums through any one of the four gears, the combination effectually providing against the possibility of a total breakdown at any time.

The two engines are each of the double cylinder high pressure type, as considerations of starting under heavy load are more important than the economy in steam consumption that would be obtained by the use of compound engines. The cylinders are 8 in. diameter × 8 in. stroke, and each engine can develop 110 B.H.P. with steam at 150 lb. pressure. With the two engines in action, the gear will lift against a strain of 25 tons at the rate of 1 knot per hour, which will be found sufficient to deal with cables in any depth of water.

Each engine drives on to its first gear shaft by a cast-steel double helical bevel gear, with machine moulded, but uncut teeth, the arrangement being such that the driving pinion can be shifted out of gear when required. Each machine has two different reduction gears, either of which can be put into action by sliding the spur wheels in and out of mesh after the manner of the gears employed on automobiles. A sliding gear wheel on an intermediate shaft is provided, by which the two systems can be connected together, so that either engine can drive either drum through any one of four different gears, which are all of different ratio, the maximum giving 4 knots per hour, at which speed a pull of 6¼ tons can be exerted. In this system of gearing, all wheels not required for actual driving are completely out of gear. The machine frame is substantially constructed with steel plate sides well braced together.

The drums, which are 5 ft. 8½ in. diameter and 1 ft. 9 in. wide between the flanges, are made to overhang and run loose on their shafts. Each is driven by a pinion, gearing into an internal gear ring attached to the drum; these pinions slide in an axial direction in and out of gear. It will thus be seen that no clutches of any kind are employed. As the brake ring is attached to the drum, it is only necessary to have the drum and holding-back gear running when paying-out. Another advantage of the fixed shaft is, that the drum shaft and the intermediate shaft also act as ties and greatly strengthen the frame. Lubrication of the drum bearings is effected by large grease cups, which are attached to the fixed shaft, so that they can be tightened up while running. It should be mentioned that the position of the internal gear rings on the drums allows of the pinion shafts being supported by outer bearings, a point of great importance, since the provision for the sliding of the pinion prevents the inner bearing being close up to the pinion when in the driving position.

The main brakes consist of steel bands lined with elm blocks. They are made to close on the drum by means of a double thread screw, actuated by a hand wheel through worm gear, which gives a very fine regulation for the lighter strains, and at the same time gives enormous holding power. The back of each brake is fitted with a water service pipe,



Double Combined Picking-up and Paying-out Machine for the U.S. Cable Ship "Burnside."

with nozzles at intervals, for directing jets of water between the joints of the brake blocks inwards, right on to the surface of the brake path. Water is supplied by a small Worthington steam pump. It is possible to utilise the effect of both brakes at once on one drum by coupling the drums together. The brake bands are held away from the drum when off by springs at several points.

The hauling-off and holding-back gears are mounted on the spar deck, and are each driven by a silent saw-tooth chain from a shaft carrying a sliding pinion, which can be made to engage with the internal gear ring on one of the main drums. They are provided with a friction brake and free wheel arrangement, so that they are driven in one direction only; that is to say, for the picking-up direction, they revolve with a slightly higher peripheral speed than the main drum, and thus keep the cable tight. When paying out, however, they are held back by the brake, and allowed, by the free wheel, to revolve with a slower peripheral speed than that of the main drum. When, therefore, it is necessary on a picking-up job to reverse and pay out a little slack, the gear acts quite automatically. This is a great advantage over the older system, in which it was necessary to put a clutch in and out of gear. A screw gear is also provided for traversing the haul-off sheave across the face of the drum to suit either an inside or outside lead, and this can be worked while the machine is running.

The two main brake wheels, the two steam stop valves, the engine reversing gears and drain cock handles are all within reach from one position. The hand wheels for putting the various gears into action are all close by, as well as the levers for the putting into action and regulation of the hauling-off gear.

It is only necessary to go below to couple the two engines, or to adjust the fleeting knives when the cable is being first passed round the drum.

The total weight of the machine is about 31 tons.

THE GEARLESS MOTOR-OMNIBUS.

Following hard upon the heels of the "Electrobus," and, doubtless, anything but grateful to that same for the "friendly lead," comes another scheme for operating omnibuses—in this case, however, only partly by electrical means. The system is that known as the Auto-Mixte, of M. Henri Pieper, and is therefore not new in principle, for a Pieper petrol-electric car was shown at Paris in 1899. Into the present design, however, notable improvements have been introduced, the chief being the suppression of the change-speed gear. The title "Gearless Motor-Omnibus" is hardly accurate, for the main driving gear and differential are retained; but the gear is of constant ratio.

An English company is being formed to introduce the system, with Mr. E. Manville, of Messrs. Kincaid, Waller, Manville and Dawson, as chairman, and with the support of Mr. Phillip Dawson, of the same firm.

A lengthy article by M. E. Hospitalier, the well-known electrician, was published in *L'Industrie Electrique*, of January 10th last, in which a full description of the Auto-Mixte car was given. From this source we derive the following particulars as to the general arrangement and characteristics of the system:—

A four-cylinder petrol engine drives a four-pole shunt-wound dynamo, of which the armature is keyed on the main shaft. The dynamo is connected with a battery of accumulators, and acts as a generator or a motor according as its E.M.F. is greater or less than that of the battery. The main shaft is provided with a magnetic clutch, of which one-half, fixed on the shaft, carries a magnetising coil, while the other half, an iron disk, is keyed on the driving shaft of the differential. On the other side of the iron disk, fixed to the frame, is a second plate provided with a magnetising coil, for braking purposes. The battery consists of 24 cells, weighing in all 3 cwt., and capable of discharging momentarily at 200 amperes; it supplies current to the ignition apparatus, the clutch, brake and lamps.

The working of the system is almost obvious; but we may briefly explain it, as follows:—The battery is never completely discharged, but acts rather as a tramway buffer battery. It drives the dynamo as a motor to start the petrol engine, which then drives the dynamo as a generator to charge the battery, if necessary; the magnetic clutch provides for a smooth and easy start. Ascending hills, the battery assists the engine by driving the dynamo as a motor; descending hills, the vehicle drives the dynamo as a generator, "regeneratively" charging the battery and electrically braking to control the speed. To stop the vehicle and to hold it on an incline, the magnetic brake is utilised, and to drive the vehicle backwards, at a low speed, the dynamo is reversed and driven by the battery as a motor. The extreme flexibility obtained by the combination must be admitted.

The dynamo is provided with auxiliary commutating poles, which enable the speed to be varied between 400 and 1,600 r.p.m. by variation of the field strength, without sparking. But what M. Hospitalier calls the really new point which has rendered practical the use of the Auto-Mixte car is an automatic magnetic device with differential windings, which controls the gas admission valve of the carburetter in such a way that when the battery is fully charged the petrol engine develops only sufficient power to drive the vehicle, while when the battery is discharging the full power of the engine is called forth. Thanks to this device, the controlling gear is reduced to a simple steering wheel and a lever, the latter operating the whole of the starting, speed regulating, and reversing movements. There is also a clutch and brake pedal.

The intensity of the ignition spark is automatically varied by the controller to suit the speed, instead of advancing the ignition with constant intensity of spark. A mechanical brake is provided.

M. Hospitalier states that the Auto-Mixte chassis is no heavier than that of an ordinary petrol car of equal maximum power, and he speaks of the system most highly—for motor-cars.

Mr. W. Worby Beaumont has reported on it, stating that it is the simplest petrol-electric system yet devised, and that it secures economy of working; but he says the weight is greater than with ordinary change-speed gear. Mr. Beaumont carried out various successful tests, described in his report, and arrived at the non-committal "opinion that the Pieper system is one of great importance for all kinds of road motor vehicles." Mr. J. Macgregor, of Messrs. Johnson & Phillips, also reported on the car, which he considered "up to the present the best and most efficient system that has been evolved either for heavy traffic or public and private vehicles.

Technically, no doubt, the system is excellent. We always have to recall the attention of enthusiasts, however, to the question—*what will it cost?* We have praised the petrol-electric system for private motor-cars, where cost is a negligible factor, but directly a project is mooted for public service the question of cost leaps into the foreground, and dominates all other considerations.

Here we start with 2d. a 'bus-mile for tires alone; add to that the cost of petrol, the maintenance of a petrol motor and gear and that of a battery; add interest at 5 per cent. and depreciation at 25 per cent., and tell us, is the total less than 1s. per 'bus-mile? We doubt it. And unless it is less, the plain petrol or steam 'bus will score.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electric Winding in Collieries.

With reference to your review on my remarks, inserted in your issue of to-day, kindly permit me to state that: (1) Mr. Mountain does not contest the official figures of the Zollern Colliery, but makes a small correction in the depreciation, due to a slightly smaller quantity of coal wound in the double shift, which brings the figures at the Zollern Colliery from 5s. 7½d. to 6s. 1¾d. Even taking Mr. Mountain's corrections, the figures for the Zollern Colliery are:—

Winding double shifts, total cost per 100 tons 1s. 5¾d.

Ditto, including interest and depreciation at 10 per cent., 6s. 1¾d.

The same figures for the Sherwood Colliery as given in Table No. I. of Mr. Mountain's paper are respectively 4s. 8½d. and 6s. 3¼d., but from Mr. Mountain's latest corrections I see that these figures should be 3s. 1½d. and 4s. 8½d. respectively.

My first statement, based on Mr. Mountain's original figures, which I took as correct, holds good, therefore, for the Zollern engine working with the output it was built for.

I quite agree with you that it is desirable to compare results from British practice, but, in the absence of the latter, a comparison between winders of approximately the same output and depth, and winding at about the same speed, after making correction for any differences in wages and the price of coal, is quite satisfactory, and should be allowed.

At any rate, the actual cost of the Zollern electric winder of 1s. 5¾d., and 5s. 7½d. inclusive of interest and depreciation, compares favourably with the average of Mr. Mountain's 12 steam winding collieries, for which the same figures are 5s. 10d. and 9s. 8¾d. respectively. Especially the first figures are interesting, as they are not influenced by the number of shifts.

Gerald Hooghwinkel.

London, S.W., *April 30th*, 1906.

Electric v. Petrol Omnibuses.

The appearance of that "bolt from the blue"—a practical electric omnibus running in the streets and earning great encomiums as to comfort and ease of control—has startled the petrol and steam omnibus would-be monopolists, and has raised a somewhat acrimonious criticism in those papers representing their interests.

I am not connected with the Electrobus Co., but I am a great believer in the electric omnibus, and it is quite capable of full proof that they are practicable, and with the removal of prejudice, must come to stay; the advantages more than outweigh the disadvantages.

Many electric omnibuses have been tried in London, Paris, Berlin, and in the United States. The present Electrobus, in my opinion, marks a distinct advance on all of these. Usually an old type of horse-drawn omnibus was adapted and altered into an electric omnibus, whereas the present Electrobus has been specially designed for the purpose.

Question has been raised as to the comparative costs of electric and petrol omnibuses, taking comparative figures as to weights approximately as correct, viz.:—

	Electric 'bus. 10—20 H.P.	Petrol 'bus. 24 H.P.
Underframe and wheels	1¼ tons	1¼ tons
Carriage body	1 „	1 „
Electric motor and gearing	½ „	—
Engines, tanks, gearing and petrol ...	—	1¼ „
Accumulators to give 20 H.P. for 5 hours	2 „	—
	4¾ tons	3½ tons
Passengers, say	2 „	2 „
	6¾ tons	5½ tons

The electric omnibus, with a battery of suitable power, weighs about 1¼ tons more than a petrol omnibus, but the total weight, with passengers, of 6¾ tons is not prohibitive on many routes in London and other places. The cost of electric energy at ¾d. per unit—a price well within the cost of production—would be for a 120-mile run of the electric omnibus about 10s. per day with average loads; and the depreciation of the battery, taking its first cost at £300, with a complete renewal, or equivalent in making up the electrodes once in each year, would cost £1 per day on the 30 working days, or a total of £1 10s. per day, as given in the prospectus of the "Electrobus."

Petrol for the same run of 120 miles, and the same average load, would cost at present prices 20s. per day; and if the depreciation of the present somewhat immature type of petrol engine and gears be put at 10s. per day, the total cost comes out the same as for an electric omnibus. The other items—cost of maintenance of tires, men's wages, interest on outlay—would be about the same in both cases.

The practical advantages of an electrical omnibus, such as absence of vibration, noise, and smell, their smooth starting and running (with saving on tires), and their comfort, will give them a preference with the public.

The fixed routes and times, with terminal charging or accumulator-changing stations, will be a most important feature, and the drawback of recharging will be overcome; and it is chiefly for this reason that I make the assertion that electric omnibuses are practicable. The accumulators, admittedly the weakest part, will have proper attention, and be under constant test and control. The destructive over-discharging which has been the most costly feature in their upkeep, will be avoided, and under these special circumstances the cost should be considerably less than hitherto: say, as was the case with the London electric cabs.

I would point out that accumulator traction was abandoned on tram lines in favour of a better way of conveying and utilising electric energy by means of wires and the trolley system, and not in favour of petrol tramcars, as might be inferred from your notice.

Henry F. Joel.

London, E.C., *April 25th*, 1906.

As one of the pioneers of the electric carriage industry in this country, may I be allowed the privilege of availing myself of your valuable space in replying to the letter from the editor of the *Automotor Journal* on this interesting subject.

At the outset I may point out that the first paragraph in the letter clearly shows the standpoint from which he views the subject, viz., as a possible competitor to the petrol vehicle industry; but because reckless statements have recently been made as to the probable cost of maintaining and running an electric 'bus, this is no excuse for equally reckless and unsubstantiated statements to be made regarding the upkeep of a battery of accumulators for an electric landaulette or brougham, which in his letter is put down at 6d. per mile run.

The actual cost of maintaining and recharging a battery suitable for an electric brougham "where every advantage is taken of concentrated and collective management" should not exceed 2d. per mile. I have run such batteries for a competing firm on very inefficient vehicles at 2d. a mile and with a substantial profit.

What the actual cost of the upkeep of the petrol 'bus really is remains to be proved. That the boom is good for the manufacturers is patent to everyone, but whether the petrol 'bus is to prove a boon to the shareholders remains to be seen.

As to the statements that hitherto all attempts to use electric accumulators even on tram lines have failed in this country—I do not know of any such attempt during the last 10 years—and considering how little the accumulator has been understood and the vast improvements made during this period in the details of their construction, I see no reason why not only should tramcars be propelled by their own batteries, but that even a 'bus propelled by the same means could be run with at least as much profit as its petrol competitor, and most certainly in both cases to the greater comfort in every conceivable way to the community at large.

The way in which many of the petrol 'buses are run is, in my opinion, disgraceful, the daily increasing noise and smell will become intolerable, and I am confident that the electric 'bus will be hailed with delight by the population of this great city.

That the public would hail with delight the advent of the electric 'bus goes without saying, but whether the manufacturers of the petrol 'bus would be equally enthusiastic is another story.

Carl Oppermann.

London, N.W., *April 26th*, 1906.

[A serious attempt was made in 1901 on the Italian Railways at Bologna (we did not say "in this country") to run accumulator cars on rails, the total length of route being nearly 50 miles, and the maximum gradient 5½ per cent. The service was in operation from December, 1901, to April, 1904, when it was abandoned as an economic failure, and replaced by steam. See ELECTRICAL REVIEW, June 12th, 1903, p. 1020; December 25th, 1903, p. 1036; and June 10th, 1904, p. 960.—EDS. E.R.]

Neutralised Repulsion Motor.

Having candidly admitted his mistake with reference to the principle involved in my series induction motor, Mr. Fynn now criticises its possible performance, and in so doing makes a similar, but not so obvious, slip. Briefly, his charges are that, by analogy with his own motor, the output will be zero if a neutralising winding be used; and without it the power factor will be very low.

His mistake lies in the assumption that because the current in his armature is in quadrature with the motor field, therefore the current in my armature is also in quadrature with the motor field. But this is not so.

The motor field in my machine is more nearly in phase with the current in the primary winding E (fig. 3, p. 575), for it forms a leakage field chiefly to this primary winding. Now, if the magnetising ampere-turns required for the whole

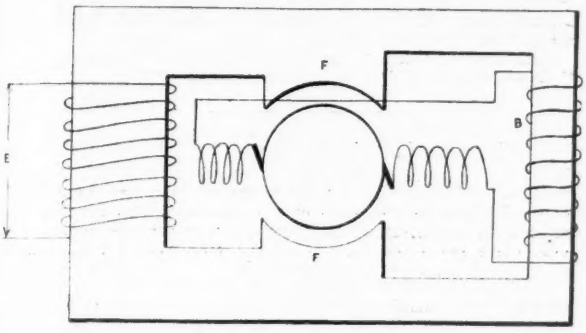


Fig. 3, from Page 575.

magnetic circuit be small compared with the ampere-turns of the secondary winding B, then the current in E will be almost in phase with the current in B, just as is the case with an ordinary transformer.

Hence the phase difference between the armature current and the motor field may be quite small. The output then will not be zero, and by similar reasoning it may be seen that the power factor may be, if not as good as in the series conduction motor, at least as good as in the ordinary repulsion motor.

The characteristics of the motor may easily be expressed by an ordinary circle diagram, when it will be seen that the benefit of the neutralising coils is in enlarging the diameter of the semicircle. I wish to point out that there was a serious misprint in the last few lines of my last letter; for "due regard being paid to the ratios of turns to the various magnetic reactances," read, "due regard being paid to the ratios of turns *and* to the various magnetic *reluctances*."

William Cramp.

Manchester, *April 30th*, 1906.

In my letter of the 21st inst., which puts a rather different complexion on the matter, I have explained in what manner I mistook Mr. Cramp's motor for a series machine. As to the principles which Mr. Cramp refers to in his last paragraph, and which he thinks I have not grasped, it seems to me that he himself is not very clear as regards either these principles or the motor he has proposed.

I agree to his first proposition; his second is, however, somewhat misty. Taking the case of Mr. Cramp's motor, where E is the primary of a constant potential transformer, it is clear that as the current taken from coil B tends to increase, so does the transformer flux due to E and threading B diminish; more and more of it taking its way through the air-gap and the armature. The phase of the E.M.F. due to B, and the phase of this transformer flux, part of which acts as motor field, however remain the same, *i.e.*, always in quadrature. Any attempt to increase the current taken from B and led into the armature, will cause a very large increase of the motor field for a very small increase of the armature current, unless the air-gap is very large. This reminds one faintly of the conditions in a series motor, but that is the most that can be said for it in that respect.

Assuming now that Mr. Cramp's neutralising coil is fully effective, then the armature current will be in phase with the E.M.F. induced in B, whatever proportion of the transformer flux threads that coil, and consequently in quadrature with the transformer flux and with the motor field. Result—no torque.

Take the neutralising coil away, then the armature current will lag very nearly 90 degrees behind the E.M.F. due to B; a torque will now result, but the power factor will fall to something like ·3, unless the losses are made very large, when it may reach ·5.

If Mr. Cramp can obtain from the coil B an E.M.F. of *same* phase as the motor field, then he will begin to approach conditions which may lead to a practical solution.

As to commutation, it is perhaps a little early to talk about it just now, but the motor cannot of course be better off in that respect than if the reducing transformer were not combined with the motor.

The machine cannot be referred to as an "induction" motor, because the working E.M.F. is not induced in the armature but conducted into it.

My attempt at a new classification has not been published yet, but it will be published shortly.

In case Mr. Cramp wishes to continue this discussion, and in order not to "cross" letters again, I will not send in another communication until May 18th.

Val. A. Fynn.

London, *April 27th*, 1906.

Separation of Oil from Feed Water.

The letter in your issue of April 20th from Mr. J. Rutherford Blaikie, giving an account of experiments with a centrifugal cream separator, is very interesting. It has often occurred to me that something might be done in this direction, but I am afraid the system would, even if entirely successful, be too costly for every-day work.

In his letter in your issue of April 27th, "J. B." accuses me of partiality. This is a charge which everyone expects who attempts to record their experiences of rival systems.

In fixing the cost of treatment at 25s. or 30s. per week, "J. B." does not mention what amount of greasy water was to be dealt with. I have in my original article given the cost for chemicals, and if automatic self-cleansing filters be employed, the only charges for them will be for cleansing water and the occasional renewal of sand.

The chemical or electrical systems of course cost something to maintain, but they absolutely remove *every trace* of oil from the water, which no exhaust steam separator with or without baffles has ever done when dealing with high speed condensing engines and high pressure steam.

There are in London at the present moment power stations where absolute oil-separating plant of either chemical or electrical type has been installed, because the exhaust steam separators were passing sufficient oil through them to endanger the boilers. The two systems can be seen side by side as the exhaust separators were left in position, and the water discharged into the absolute separating plant is white, opalescent, and has a quantity of free black oil floating on the top in globules.

"J. B." evidently believes that the emulsion is formed in the condenser; this is erroneous—the mischief is done by vapourisation of the oil in the steam cylinders. I can readily believe that there are baffle separators which have been running for eight years, and have "never either been cleaned out or had a cover taken off for any purpose since being erected." I know of no reason for either operation.

My apologies are due to Messrs. Davis-Perrett, Ltd., for overstating the consumption of energy by their apparatus. I note that it need seldom be as high as 1 unit per 1,000 gallons.

J. H. Harwood.

London, E.C., *April 30th*, 1906.

Overhead Mains.

We thank you for your reply to our letter published in your issue of March 30th, and for the advice you then gave us. In the interim we have investigated the question somewhat more fully, and have gone over the Board of Trade's publications, of which you gave us particulars. In these we see that for pressures of *over* 500 volts, each cable must not

carry more than 50 KW. The pressure on our line is to be 500 volts, but to make up for drop we purposed having an initial available pressure of about 550. We shall be glad to know if you think this small increase would force us to conform strictly to the regulations.

Do you know of any cases where private parties have run a cable across public streets, on poles situated on either side of the road in the territory owned by some other party? We have ourselves often run cables across the street, but then the attachments on either side have been the property of the owner of the cable. It would obviously be an awkward matter if anyone had the right to order them to remove the cable once it had been put in working order.

Power.

[This matter arises out of a "Legal Query" in the issue mentioned. We take it that the Board of Trade regulation in question relates to the pressure of supply; so long as this does not exceed 500 volts, a reasonable allowance for pressure drop is not likely to be objected to—it is permitted on overhead tramway conductors. As regards the second question, there are undoubtedly very many such cases. Being, as a rule, without statutory rights, the owner of the cables must of course protect himself by agreements with the owners of the property traversed and with his consumers.—EDS. E.R.]

Electric Riveter.

Can you inform us if there is on the market an electric riveting machine or hammer suitable for use in steel bridge work, and if so, will you kindly give us the name and address of the manufacturers?

J.

[We have never met with an electric riveting machine, though percussion drills have been electrically driven, with success. In our issue of November 18th, 1904, we described the Gibson patent electro-pneumatic rock drill, in which the pneumatic drill (which might be replaced by a pneumatic hammer) is actuated by a little electrical air "pressor"; the latter consists only of a cylinder and piston, the piston reciprocating with the same frequency as the drill.—EDS. E.R.]

LEGAL.

VYE *v.* ISLE OF THANET ELECTRIC TRAMWAYS AND LIGHTING CO., LTD.

MR. JUSTICE JELF, sitting with a common jury in the King's Bench Division on Friday, heard an action by plaintiff, a grocer and provision merchant, Ramsgate, for damages occasioned by a tramcar, belonging to defendants, leaving the track and dashing into plaintiff's shop front, where it had to remain embedded until the building could be shored up. Defendants had paid £100 to the landlord, and the plaintiff now sought to recover in respect to shop fittings and chattels which were destroyed, and loss of profits while the shop was closed for repairs.

The jury found for the plaintiff for £50, but the defendants having paid £80 into Court, his Lordship entered judgment for them directing the money in Court to be set off against their costs.

AGINCOURT STEAMSHIP CO., LTD., *v.* THE EASTERN EXTENSION AND CHINA TELEGRAPH CO., LTD., AND ANOTHER.

THIS case came before the Court of Appeal, consisting of the Master of the Rolls, and Lord Justice Romer, on Monday, on the appeal of the defendant company from an order of Mr. Justice Kennedy in chambers, refusing an application of the company that the plaintiffs' statement of claim might be struck out, or in the alternative, that it should be amended by striking out one or other of the defendants.

MR. HAMILTON, K.C., in support of the appeal, said his contention was that the plaintiffs had delivered a statement of claim that was contrary to the rules, as forming two causes of action which related to two distinct torts. What they wanted was to have one or the other of the defendants struck out so that they could know where they were, or that the plaintiffs should be put to election, and say which of the two defendants they proposed to proceed against. Appellants were a telegraph company, and the second defendants, the Great Northern Telegraph Co., were also a telegraph company, and the plaintiffs were the owners of the ss. *Agincourt*. Defendants owned telegraph cables in the Yangtse Kiang River, and on August 31st, 1905, the *Agincourt* was anchored there, while on a voyage from Shanghai to San Francisco. A typhoon came on, and both port and starboard anchors had to be dropped in the course of September 1st. On September 2nd it was found that the anchors had dragged, and the *Agincourt* was in dangerous proximity to the shore. An attempt was made to get up the anchors, but it was found that they were both foul of a telegraph cable, and to save cutting the telegraph cables the anchors were slipped and buoyed. The defendants by public notice had offered to compensate owners of ships who slipped their anchors in order to avert injuring the cables, the notice being signed on behalf of both companies. The plaintiffs brought the action against both companies, without specifying whose cable they alleged their ship fouled, and he submitted that the defendants were entitled to know what the case made against them was, whether it was an allegation of joint tort or to be taken as alleging separate torts.

Lord Justice ROMER said he thought the meaning of the allegation was simply that the plaintiffs did not distinguish between the two companies.

MR. PICKFORD, K.C., for the plaintiffs, contended that the statement of claim alleged a joint cause of action, but he was not content to be bound by that definition, as he did not rely only on a joint claim. He had a perfect right to submit two causes of action in respect of each cable.

Their LORDSHIPS said that that being so, the plaintiffs must amend their statement of claim, and he gave leave accordingly.

UXBRIDGE AND DISTRICT ELECTRIC SUPPLY CO., LTD.

IN the Chancery Division on Wednesday last week, Mr. Justice Buckley had before him a petition by the company for the sanction of the Court to the alteration of the company's memorandum of association, so as to enable it to extend its business to the County of Hertford and elsewhere. At present, the company had powers to supply electricity in the County of Middlesex and Buckingham.

MR. MANGHAM, who appeared in support of the petition, said the business of the company had been growing, and it would be convenient if the company could carry on business in the County of Hertford.

His LORDSHIP: Do you want to go to Northumberland or Ireland?

MR. MANGHAM: It is conceivable we might wish to go through Hertford.

In the result, his LORDSHIP granted the application, allowing the company to extend its business to Hertford and the adjoining districts.

MR. MANGHAM said he hoped the company would not have to come to his Lordship to say what a district was.

PARLIAMENTARY.

L.C.C. Tramways.

ON Thursday, April 26th, evidence was given by Mr. Harper, the statistical officer to the Council. He put in a large number of tables showing the number of passengers carried by the omnibuses and the tramcars both at Westminster and Blackfriars Bridges. These showed that the number of passengers brought to the Westminster terminus by the trams was about 27,500 per diem. Practically all these passengers he thought would continue their journey across the bridge if the trams were able to take them.

Cross-examined by Mr. LEWIS COWARD, K.C., WITNESS would not admit that the tramlines would create any congestion of traffic. He said that he considered that the extension of the trams over the bridges was necessary.

By Mr. HUTCHINSON: No tramcars would stop on the approaches of Blackfriars Bridge. There would be a stopping place on the Embankment.

Re-examined: There would be ample margin for four lines of traffic on Westminster Bridge beside the tramlines. The speed of the cars and the working were under the control of the Board of Trade, who would doubtless afford all necessary protection.

Mr. A. L. C. FELL, chief officer of the Council's tramways, was then called. The proposed tramways would form a most valuable and important connection of the Northern with the Southern systems. At present the working of the terminus at Westminster gave the Council a great deal of trouble and was most inconvenient to the public. The circular route along the Embankment would lessen the inconvenience very considerably. In his opinion fully 90 per cent. of the passengers who came to the bridges would continue the journey across. A certain number of the cars crossing the bridges would be single-deck cars, and in order that the number of cars should not be unduly increased, it was proposed to run the larger size of cars in conjunction with these single-deckers. He estimated the expenses at 7d. per car-mile and the takings at 1s. per car-mile on a minute service. The receipts he put at £46,000 and the working expenses at £27,000 a year. That would give a gross profit of £19,000. With regard to the competition of motor-'buses, he said that it was a fact that while there were several cases where motor-'buses ran over the same routes as the Council's tramways, the receipts of the tramcars had actually shown an increase. In the course of further evidence, witness gave the figures of the takings by the Council's tramways for the week ending March 31st last. They were as follows:—Sunday, £1,415; Monday, £1,982;

Tuesday, £1,845; Wednesday, £1,950; Thursday, £1,903; Friday, £1,858; and Saturday, £2,559.

Capt. Fitzroy Hemphill, Chairman of the Tramways Committee of the Council, gave similar evidence, and

Mr. Andrew Young, the valuer to the Council, spoke as to the valuation of property on the proposed route.

On Friday, April 27th, the first witness called was the Mayor of St. Pancras, who spoke to the necessity of the proposed extension over the bridges. The Mayor of Lambeth, who was also called, said that there had been a strong feeling in his borough on the subject, and a resolution had been passed requesting him to appear before the Committee in support of the scheme. This concluded the case for the promoters.

Mr. Lewis Coward, K.C., then addressed the Committee on behalf of the opposition of the omnibus companies. One company, he said, carried over 200 million passengers annually. With regard to the proposal to take trams along the down stream side of Westminster Bridge, he thought that it was a poor tribute to the intelligence of the officials of the L.C.C., that after having brought in their scheme year after year with the trams in the centre of the bridge, they had now admitted that the scheme was badly conceived, and they now proposed that the lines should be at the side of the bridge. The whole of last year's evidence was based on the assumption that the middle of the road was to be used. The scheme as set out would give the County Council a monopoly of one side of the bridge. If the cars were stopped on the Surrey side of the river, and kept there until three or four were taken over the bridge close together, it would mean that the traffic both north and south would be held up. As to the subway being any means of communication between the north and south, he regarded it as a common fallacy. The passengers would have to change in any case, because the single-deck cars carried only half the number of passengers conveyed by the double-decked cars. The financial basis of the scheme was unsound, and a million of the ratepayers' money might be spent and wasted.

Mr. Richard Tilling, managing director of Messrs. Thomas Tillings, Ltd., gave it as his opinion that sooner of later motor-omnibuses must become the mode of traction for the public. The trams would constitute an unfair competition, as they would carry passengers over the bridge for nothing.

By Mr. Erskine Pollock: The 'bus companies might reduce their fares for long-distance traffic, but it would not be profitable. The 'bus companies had to pay 20s. in the £, but the L.C.C. had the rates to make up their losses.

Mr. Perry, managing director of the Star Omnibus Co., gave similar evidence, and said that his company had 20 motor-'buses running at the present time, and would shortly have 40 more.

Superintendent Beard, of the Metropolitan Police, who attended at the request of the Committee, and was examined by the Chairman, said that the proposal to put the lines on the down river side of the bridge would greatly do away with any possible obstruction to the Parliamentary crossings.

Superintendent Norice, in charge of the traffic on the south side, thought that there would be no difficulty in bringing the trams round on to the bridge from Stangate.

The Chairman said that the decision on the Bill would be given when the other portions of the Corporation's Bill had been considered.

On Monday the Committee considered the Corporation of London's Bill, which has a bearing on the County Council's scheme, inasmuch as it provides for the widening of Blackfriars Bridge.

Sir Ralph Littler, K.C., said that on account of the interference with traffic the proposal to bring the trams over the bridge was originally opposed by the Corporation. Now, however, it had been agreed to widen the bridge from 75 to 105 ft., and the cost would be borne by the Bridge House Estates. The tramway on the bridge would remain the property of the Corporation, the terms upon which it would be used by the L.C.C. being a matter for agreement. For the convenience of pedestrian traffic it was proposed to construct a subway under the approach to the bridge.

After hearing evidence, the Committee passed the preamble of the Bill.

The Chairman said that before the Committee could give any decision on the L.C.C. Bill they would have to hear evidence as to the financial position of the Council's tramway undertaking.

Mr. Erskine Pollock then addressed the Committee on the Tramways No. 10, 11, 11*a* and 11*b*. No. 10, he said, was a tramway commencing at the terminus of the existing tramway in the East India Dock Road, and terminating at Barking Bridge, which was the county boundary. About a quarter of a mile from Barking Bridge was the line belonging to the West Ham Council. He understood that they would have been very glad if the quarter of a mile could have been bridged, so that the two lines might have been connected; and no doubt if the County Council line was passed, the West Ham Council would come to Parliament for power to connect up the two lines. The tramway with which he was dealing was passed by Parliament in the year 1900; but owing to one or two matters—one being the fact that the adjacent tramways belonged to the North Metropolitan Tramways Co.—the scheme was allowed to stand over. When it was proposed to take over those tramways belonging to the North Metropolitan Co. the County Council last year came to Parliament for an extension of time. No opposition was offered to the Council's first Bill, nor to the extension of time Bill, but this year the Bill was opposed, but by only one petitioner, that petitioner being the East India Dock Co. The roadway along which it was proposed to take the trams varied in width from 40 ft. to 55 ft. 7 in., and the carriage way from 24 ft. 10 in. to 35 ft. 2 in. That being so, it was proposed to reduce the footway on the south side of the road from 6 ft. to 3 ft. In order to do this they had to insert a special clause in the Bill, because by the Act of 1901 the Council had no power to reduce a footway to a less width than 6 ft. The Dock Co. who were opposing the Bill were frontagers in the sense that they had a dead wall which ran right along the south side of the roadway, except for a very short distance, and their contention was that by lessening the width of the footpath their interests would be affected. Counsel thought that the Dock Co. were somewhat ungrateful in opposing, for when the Blackwall Tunnel was made the Council effected a widening at the gates of the Dock Co.'s premises. That, however, seemed now to have been forgotten. The cost of the tramway No. 10 would, it was estimated, be £30,000, a small widening at one point costing some £3,800. Tramways 11, 11*a*, and 11*b*, were short lengths of line leading from the main tramway to a car-shed. They would together cost a further sum of £9,600. All the lines would be constructed on the conduit system.

Mr. Maurice Fitzmaurice, engineer to the Council, said that the line No. 10 was 4 furlongs 5 chains in length. Witness further bore out Counsel's opening statement; and said that the lines when connected up would serve the districts of Barking and Plaistow, which contained a large working class population.

By Mr. Balfour Browne, K.C. (for the Dock Co.): The question of widening the roadway was considered some years ago; but now that it was proposed to take a part of the footway, he did not think that it was necessary to embark upon such a widening.

Mr. Fell, tramways manager to the Council, also gave evidence, and Mr. Harper, statistical officer to the Council, and Mr. Andrew Young, the Council's valuer, were also called.

The last witness said that in his opinion the Dock Co.'s premises could not possibly suffer from the reduced pavement.

Mr. Sydney Holland, deputy chairman of the Dock Co. and chairman of the Poplar Hospital, was then called in support of the case of the Dock Co. Examined by Mr. Balfour Browne, K.C., he said that in his opinion the roadway, especially opposite the Poplar Hospital, was far too narrow to admit of the laying of two lines of tramrails. The road was very congested at all times, and was the main thoroughfare to all the large docks.

On Tuesday the proposal to construct a tramway from the East India Dock Road to Barking Bridge Road, where it will eventually join up with the tramways of the West Ham Corporation, was considered.

Mr. Balfour Browne, K.C., on behalf of the London and India Dock Co., said that his clients had now come to an agreement with the Council. They were not opposed to the tramway, but were of opinion that the road along the docks was at present too narrow for a double line of tramways. By the agreement which had been come to, the Council would take powers on condition that the tramway would not be opened until the roadway was widened.

The Committee consequently allowed this proposal, and proceeded next to deal with the scheme for the construction of a tramway from Kilburn to the Marble Arch *vid* Edgware Road, with regard to which the Middlesex County Council were making proposals.

Mr. Pollock, K.C., said that an arrangement had now been come to between the London County Council and the Middlesex County Council by which the portion of the tramway from Kilburn Priory to Cricklewood would be constructed, equipped and worked by the Middlesex County Council, whereas that portion from Cricklewood to the Marble Arch would be constructed, equipped and worked by the London County Council. An agreement has also been come to with regard to the street widenings, the cost of which was estimated at £95,000, one-third of which would be borne by the L.C.C. and two-thirds by the Middlesex C.C.

Mr. H. Lloyd, K.C., said that the Middlesex County Council would construct their lines on the overhead system, while the L.C.C. would have the conduit system.

Evidence in support of the proposal was then called.

(To be continued.)

London County Council (Electric Supply) Bill.

The Select Committee of the House of Commons, which has been appointed to consider the London County Council's Electric Supply Bill, commenced its sittings on Tuesday last in the large Committee Room at the end of Westminster Hall, Mr. Luke White presiding.

The London County Council were represented by Mr. Freeman, K.C., Mr. Lewis Coward, K.C., Mr. Clode and Mr. Cleese. The following is the list of petitioners against the Bill, though many of them were not represented by counsel:—Beckenham Urban District Council; Bermondsey Borough Council; Bexley Urban District Council; Bromley Corporation; Chiswick Urban District Council; Corporation of the City of London; Croydon Corporation; Dartford Rural District Council; Dartford Urban District Council; Ealing Corporation; Finchley Urban District Council; Fulham Borough Council; Greenwich Borough Council; Hackney Borough Council; Hammersmith Borough Council; Hampstead Borough Council; Hendon Urban District Council; Hornsey Corporation; Ilford Urban District Council; Islington Borough Council; Kensington Borough Council; Leyton Urban District Council; Middlesex County Council; Poplar Borough Council; St. Marylebone Borough Council; St. Pancras Borough Council; Shoreditch Borough Council; Southwark Borough Council; Stepney Borough Council; Surrey County Council; Tottenham Urban District Council; Walthamstow Council; Wanstead Council; West Ham Corporation; Westminster City Council; Willesden Urban Distric

Council; Wimbledon Borough Council; Central Electric Supply Co.; Charing Cross, West End and City Electricity Supply Co.; City of London Electric Lighting Co.; County of London Electric Lighting Co.; companies supplying electrical energy in the Administrative County of London; Kent Electric Power Syndicate; Kensington and Knightsbridge and Notting Hill Electric Lighting Co.'s; Metropolitan Electric Supply Co.; North Metropolitan Electric Supply Co.; St. James' and Pall Mall Co.; South London Electric Supply Corporation; South Metropolitan Electric Light and Power Co.; Westminster Electric Supply Corporation; Brentford Gas Co.; Grays Gas Co.; Gas Light and Coke Co.; South Metropolitan Gas Co.; Commercial Gas Co.; Mitcham and District Gas Co.; Wandsworth and Putney Gas Co.; West Kent Gas Co,; Central London Railway Co.; Great Central and other railway companies; Whitechapel and Bow Railway Co.; Metropolitan Water Board; London Hydraulic Power Co.; promoters of the Administrative County of London Bill; Surrey Commercial Dock Co.

At the outset of the proceedings Mr. Balfour Browne, K.C., said that in most cases the Committee would see that counsel had been reserved. They had purposely formed a group of companies to save the time of the Committee, and they proposed to call before the Committee witnesses to speak for the whole of the companies, and so shorten the inquiry very much. If necessary at any time, any one of those companies could enter an appearance.

The Chairman said that he was very glad that an effort had been made to save time.

Mr. Freeman, K.C., then opened the case for the promoters. He said that the Bill was for the purposes of conferring powers upon the London County Council to supply electrical energy in the Administrative County of London and neighbouring places. The intention was first of all to supply electrical energy in bulk to authorised distributors, and then to supply power in bulk to Government departments, railway, tramway, canal and dock companies, &c. It was not proposed to supply direct to consumers without the consent of the local authorities or company within whose area the consumer might be. The Bill was, in fact, a purely permissive Bill, and no one would be under any obligation to take a supply. With regard to the proposal to supply power in bulk to railways, dock companies, &c, Mr. Freeman said that the proposal was to supply such companies in cases where the undertaking was within the area of more than one authorised distributor. Such authorised distributors had no power to supply outside their area. The importance of an adequate supply of electrical energy for London had become obvious, and it was important that such a supply should be in the hands of the municipality. The scheme proposed by the L.C.C. was, he contended, a good scheme and a practical scheme for the purpose. Hitherto manufacturers had suffered from the diversity in the prices charged, and this it was proposed to remedy. At the present time there was a great demand for further bulk supply to London as a whole. The trade of London had this peculiarity that it contained many small manufacturers to whom a cheap supply for power purposes was necessary, and to whom any saving in labour resulting from such a supply would make a material difference. Such a supply, then, should be given without delay, and it was most undesirable that it should be left in the hands of the trading companies. London had no wish to learn again the lesson which it had learned in regard to water, and Parliament had all along contemplated the purchase of the electric supply undertakings by the local authorities. The L.C.C. had very exceptional advantages for giving such a supply. The Council had a large station in an excellent position at Greenwich, with the benefit of cheap coal conveyance and ample water condensing. Then the Bill proposed that another station should be erected at Battersea. It was necessary to consider, and witnesses would be called to speak on the point, whether it was not better to have stations near London rather than to have them outside and bring the supply from a great distance by means of cables laid along the railways or by overhead cables. In his opinion, the scheme as set out would prove commercially profitable. Counsel then went at considerable length into the history of the various Acts dealing with the question of electricity supply in London, and pointed out that the time when the electric supply undertakings of the companies would become purchaseable had been made uniform, as the Act of 1882, which provided for their purchase by the local authorities, had been found to be fatal to electrical enterprise. In the district outside London there were now seven local authorities and three companies supply energy, and it might be said that the Council were proposing to come into competition with them. The Council, however, did not think that they ought to compete without either the consent or the request of the local authorities or companies. The promoters, in fact, felt that it would be very unjust, after allowing existing authorities to expend their capital, for the Council to enter into competition, and not even in cases where the Council would perhaps be able to supply at a lower rate did they wish to invoke the authority of the B. of T. to enter into competition with an authorised distributor. What they wished to do was to supply such distributors in bulk, and under Clause 36 of the Bill to bring about a revision of prices charged by authorised distributors every five years, should it be found on inquiry by the B. of T. that the prices were too high. Learned counsel then proceeded to speak of the existing undertaking with the County, and said that at the present time the capital expended by the local authorities on electricity undertakings was about £6,500,000, while the companies had expended a little under £12,000,000; that made a total of about £18,500,000. The capacity of the generating plant of the local authorities was 58,000 kw., the capacity of the companies' plant being 122,450 kw., or a total capacity for the whole of the plant of about 180,500 kw. The maximum load demand was as follows:—For the local authorities, 31,800 kw.; for the companies, 113,000 kw.—so that between the capacity and the maximum demand there was a considerable margin. It represented plant with a capacity of 67,000, and this was the plant which was held in reserve in case of accidents, repairs, &c. It was largely due to the multiplicity of generating stations that there was so much plant remaining idle. If the Council had those two large generating stations, the existing one at Greenwich, and the one on the proposed site at Battersea, they would act as a stand-by for the companies and the local authorities, and would release the plant which was now standing idle, it would mean, in fact, that a figure of something like 50 per cent. more power would be available and would be set free. Coming to the capital cost of the various undertakings, Mr. Freeman said that it increased, as it was split up over a number of stations. In the case of the existing companies it worked out at about £51 per kw., while in the case of the local authorities it was some £42 per kw. In the case of the L.C.C. it would be some £15 per kw., or if the cost of transmission were added it would bring it up to £30 per kw. That meant, in effect, that for every £100 spent by the local authorities, the London County Council could do the same thing for £66. That, he contended, was a strong argument in favour of the Bill. A supply of power was undoubtedly needed, and if it were given it must be cheap, and it must be uniform.

(To be continued.)

Electric Lighting Provisional Order (No. 1) Bill.—This Bill came before the Examiner of Standing Orders on Monday, and was ordered to go to the House for second reading. The Bill confirms the provisional order granted by the Board of Trade to the National Provincial Electricity Corporation, Ltd., whose registered offices are 118, Queen Victoria Street, London, in respect of the Borough of Waterford. The order contains a purchase clause providing that at the expiration of 21 years the Corporation may purchase the undertaking at the fair market value as a going concern; but if purchased before, the price shall be one to be agreed upon between the parties.

Twickenham and Teddington Electric Supply Co., Ltd., Bill.—On Tuesday the above Bill was down for consideration by Mr. Billson's Select Committee of the House of Commons; but owing to the withdrawal of the opposition, the Bill was referred to the Unopposed Bill Committee. Amongst other matters, power is given to the Hampton and Teddington Urban District Councils to transfer their undertakings to the company.

Post Office Officials and Patents.—In Tuesday's Parliamentary Papers Mr. Steadman asks the Postmaster-General whether he will explain why, in view of the amount of money expended at the General Factory, Mount Pleasant, in experimenting on electrical condensers and other work, and of the fact that the whole of the work was done at the factory and by the staff generally, some seven patents had been taken out by an officer of that factory on the results of the experiments done; and is he aware that the patents had been let on Royalty to a foreign firm, who are now manufacturing condensers on the results obtained at Mount Pleasant? Mr. Buxton, in reply, states that the officer in question has been allowed to take out patents on conditions which amply protect the interests of the Post Office and other Government departments. He thought it was to the public advantage that the inventive faculty of public servants should be encouraged.

The Holloway Postal Telegraph Factory.—Mr. Steadman asks the Postmaster-General in Tuesday's Parliamentary papers whether he can offer any explanation as to the cause of the employés at the Holloway postal telegraph factory being placed on short time; and whether orders are still being given to outside manufacturers for telegraph and telephone apparatus which could be produced cheaper at the factory, which has been recently enlarged at a considerable cost. Mr. Sydney Buxton says he regrets that it was necessary recently to put some of the hands at Holloway on short time. They had now been placed on full time again, and he is taking such steps as he can to keep the work constant, and to reduce to a minimum both short time and discharges. The factories are now receiving the orders for such apparatus as can be produced there as cheaply as outside, subject of course to the capabilities of the factories.

Ascot District Gas (Electric Lighting) Bill.—This Bill to enable the Ascot District Gas Co. to supply electricity, and to change the name of the company, came before Mr. Billson's Select Committee of the House of Commons on Tuesday, but as no opponents entered an appearance, the Bill was referred to the Unopposed Bill Committee. It is proposed to change the name of the company to that of the Ascot District Gas and Electricity Co., and to increase the capital by the issue of £30,000 new shares, and to take land for the erection of a generating station in the Parish of Warfield.

Derbyshire and Nottinghamshire Electric Power Bill.—It is reported that all opposition to this Bill has been removed.

Electric Lighting Provisional Order (No. 2) Bill.—On Monday the Examiner of Standing Orders found that the necessary formalities had been carried out with regard to the above Bill, which confirms Board of Trade Electric Lighting Orders in regard to the following districts:—Abercarn, Barry, Bettwsycoed, Blaydon, Calverley, Farsley, Foot's Cray, Horsforth, Market Harborough and Wembley. In each case the Order is granted to the Urban District Council of the district. The Barry Order simply amends the previous Order of 1901, and extends the time of compulsory works. The Bettwsycoed Order contains a special power of transfer to the Bettwsycoed Electric Lighting Co., Ltd. The Blaydon Order gives power of transfer to the County of Durham Electrical Power Distribution Co.; the Calverley and the Farsley Orders are both transferable to

the Electrical Distribution of Yorkshire, Ltd.; the Foot's Cray Order to the Foot's Cray Electricity Supply Co., Ltd., whose registered offices are Dacre House, Victoria Street, London; the Horsforth Order to the Yorkshire Electric Power Co.; and the Wembley Order to the North Metropolitan Electric Power Co.

Third Reading.—In the House of Commons on April 27th, the Macclesfield and District Tramways Bill was read a third time.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"J. B." writes:—"We propose at our colliery to light the workmen's dwellings with the electric light. We propose to charge all who care to have it so much per week for each 16-c.p. lamp. I may say that all the property, which includes workmen's dwellings, two shops, a chapel, schools, &c., is on the premises of the New Sharlston Collieries Co., Ltd. Will you kindly inform me if there is any law that can stop us from doing this, provided we take every precaution in respect to risk of fire, &c. We propose to deliver current at 100 volts pressure, and to put in two meters—one in each shop—and charge for the current 4d. per unit to start with. We are not going to put any plant down for this, as we intend to use up some surplus units we have. The overhead wires will be covered, and put up on poles and fixed to insulators. I enclose rough sketch of buildings and generating station."

*** It is quite clear that there is nothing to prevent "J. B." granting the supply of electricity upon the terms and in the manner suggested. The Electric Lighting Acts of 1882 and 1899 have no application to the private supply of electricity, while the Act of 1888 merely provides that in the case of an installation like that proposed certain regulations of the Board of Trade may have to be complied with. "J. B." is recommended to write to the Board of Trade asking for a copy of the Regulations issued by them pursuant to Sec. 4 of the Electric Lighting Act, 1888. If he comply with those regulations—and it is anticipated that he will have no difficulty in so doing—his position will be secure. We should be glad to know how those "surplus units" are stored.

RATEABILITY OF ELECTRICITY UNDERTAKINGS.

[COMMUNICATED.]

THE object of this article is not to discuss the merits or demerits of the systems which are at present used by the various assessors throughout the United Kingdom in arriving at the rateability of electricity undertakings for the purposes of taxation, but to put forward a plea for uniformity and fairness in arriving at the estimated rental.

To the close student of this very abstruse and complicated subject, it is well known that there are hardly two electricity undertakings under different assessing authorities valued on the same system. Some adopt structural value, and some the "hypothetical tenant" system, with as many exceptions and variations in the latter system as there are undertakings to assess. There does not appear to be any valid reason for this state of affairs, as every Corporation with an electricity undertaking has its accounts made up on a uniform basis, and exactly the same elements of working and governing are common to the majority of electricity supply undertakings. Then why should 50 undertakings, whose accounts only differ from one another in figures and not in principle, have 50 different methods of arriving at what is considered a fair rent on which to levy rates?

To come at once to the subject proper, there is lying before us a paper, excellent in many respects, which was read some time ago by Mr. J. Bridge, F.S.A.A., borough accountant to the South Shields Corporation, on the "Rating of Electricity Supply Works." In his paper Mr. Bridge takes concrete figures, and he shows a specimen valuation of the South Shields Corporation electricity undertaking, based on the accounts for March, 1904. The following is the valuation skeletonised :—

Gross receipts			£17,161
Deduct generating and management expenses			5,729
Net receipts			£11,432
Allow, say, 17½ per cent for interest, trade profits and risks on £10,610, which sum represents tenant's chattels and working expenses	£1,857		
Renewal of tenant's chattels	668		
			2,525
Gross value			£8,907
Deduct statutable deductions:—			
Repairs	£1,309		
Fire insurance	43		
Renewals	5,738		
			7,090
Rateable value			£1,817

Mr. Bridge is therefore of opinion that the rent which a hypothetical tenant would pay to a landlord would be £8,907. Let us now analyse the position of the landlord from this point. The hypothetical tenant, as we have seen, hands over the sum of £8,907 to the landlord, and the landlord immediately hands back to the tenant £1,309, this being the estimated average amount per year expended by the tenant on repairing landlord's capital, also the sum of £43 for fire insurance. The landlord is now left with a sum of £7,555, of which £5,738 represents the average amount which he, if he is a prudent man, will require to set aside in the shape of a renewal fund every year, in order that his capital, which, according to Mr. Bridge's calculations, amounts to £130,909, may be preserved intact.

Now, the landlord is supposed to have borrowed this sum of £130,909, on which he will have to pay interest at a rate between 4 and 5 per cent., and amounting in round figures on the aforementioned capital to between £4,000 and £5,000, and all he has to meet this claim is a sum of £1,817.

Analyse the valuation in another fashion. Suppose the undertaking had received on an average 2·84d., instead of 3·09d. per unit sold, owing, let us assume, to the supply of energy to tramways at too low a rate bringing down the average price per unit sold, then this would have meant that the revenue, instead of being £17,161, would have been £15,375, and the corresponding rateability would be valued at £31! The working, tenant's, and statutable allowances would, it must be very carefully noted, have remained exactly the same, as fluctuations in the receipts do not affect these calculations. In other words, the £8,907, which Mr. Bridge has estimated as being the rental, because it is what is left to the tenant after meeting all his claims on the undertaking, is no more or less than a "difference" and not "rent" in any sense whatever.

The method suggested for arriving at a fair rental, is to ask the question what are landlord's and what are tenant's expenses. Still taking the South Shields valuation as an example, it is found that the tenant's expenses are £8,254, and the landlord's £7,090, a total of £15,344. The landlord has a further £4,000 to £5,000 to pay for interest on his capital of £130,909, so that in effect he would say to the hypothetical tenant, you will have to charge your consumers such a price per unit as will bring in a revenue consisting collectively of your expenses of £8,254, my expenses of £7,090, plus the interest payable by me on my capital, plus a sum for me to live on. We need not carry this argument any further, but would it not be possible to make the rateability of all undertakings uniform by simply taking the figure corresponding to £15,344 for any electricity undertaking, and on the figure arrived at under this principle, taking a percentage to represent the rateability of the undertaking? This would ensure absolute uniformity of principle and system, because when receipts are taken into account in this connection, they form a most fallacious figure, as a committee can charge, generally speaking, a rate which, while making the undertaking self-supporting, will make the rateability of the undertaking an absurd figure, if such rateability is arrived at on the principle explained by Mr. Bridge.

BUSINESS NOTES.

A New Cable Drum Carriage.—The framework of this carriage is built entirely of mild steel; the wheels and shafts being of wood. It is designed to meet the need for a mechanically constructed and easily manipulated drum carriage, and the inventor has endeavoured to combine a design and strength of frame suitable to meet the varying sizes and weights of drums, and to produce a vehicle on two wheels only (these are 56 in. in diameter), and at the same time to construct the carriage so as to ensure perfect safety whilst loading, unloading and travelling. It is claimed that loading and unloading can be done by one man with perfect ease and safety. The method of raising the drums is by means of powerful worm gear fixed on the frame on the left side of carriage in a convenient position, which operates a winding spindle, and to which is attached a steel rope at both sides of carriage. The other ends of the ropes are attached to cast-steel shoes. These slide up an inclined girder, and when raised are secured in position. The frame is built up of two stout steel channels running longitudinally, to which is riveted a steel plate forming the sides of the carriage, and the whole frame is braced and strengthened by strong mild steel channel and bulb angles, which run down either side of the carriage, and give rigidity to the whole frame. The back ends of the longitudinal channels are provided with drop shoes, which are lowered to the ground when loading or unloading is being done, and secured in position. They serve to prevent any strain being put upon the horse, and adapt themselves to any irregularities of the ground. This carriage will take drums 7 ft. 4 in. in diameter and 3 ft. 10 in. in width, and can be raised to give 9 in. clearance. The weight can be balanced at will, and is easily moved backwards or forwards before climbing or descending steep inclines. The carriage is fitted with a powerful lever brake. The cable can be unwound either backwards or forwards whilst the drum is on the carriage. It requires one man and one horse only to load and convey (on ordinary roads) drums up to 4 tons in weight, and the inventor claims a very large saving in working cost with the new carriage. Communications on the subject should be sent to W. A. Turner, 13, Earl Street, Scotstoun, Glasgow.

Telephone Prices.—The General Electric Co., Ltd., wish to correct an error which they made in stating the price of one of their telephones in their advertisement in our last issue. The price for the K 142 "Bothcall" telephone was given as 17s. 6d., but it should be 21s.

Renewable Tramrails.—The Leeds Corporation have placed an order with Romapac Tramway Construction Co., Ltd., for replacing a considerable portion of their worn-out track with the Romapac patent renewable tramrail, and have decided that a length of not less than one mile shall be laid as early as possible. We are informed that this has been decided upon in consequence of the satisfactory working of a length laid down at Headingley last year.

France.—The balance-sheet of La Compagnie Francaise pour l'Exploitation des Procédés Thomson-Houston for the last financial year shows a net profit of £95,818, out of which a dividend of 25 per cent. per share is being declared.

Brush Contracts.—The following contracts have been booked by the Brush Electrical Engineering Co., Ltd.:—

For the Fine Cotton Spinners Association, 210-kw. three-phase alternator and 30 three-phase motors for cotton mill equipment.

For the Soudan Railways (Egyptian Government), sixteen main line coaches.

For the Gravesend and Northfleet Tramways Co., four double-deck cars complete with Brush trucks and motor equipments.

For the Bideford, Westward Ho, and Appledore Railway Co., four Brush trucks.

For the Plymouth Corporation, six "Demi" cars with Brush trucks and motor equipments.

B.J.M. Insulating Paint.—The British-Johns-Manville Co., Ltd., of 81, Fenchurch Street, E.C., have put upon the market an insulating paint which is specially adapted for the painting of trolley line insulators and overhead cables. The paint is also suitable for dipping armature coils or complete armatures. We understand that it is only necessary to dip the spools or windings into the paint, and stove same for four hours at 220° F. After the first dipping the armature coils could be wound with ordinary linen tape and re-dipped and stoved again for six hours at the same temperature. We are informed that the tests on many coils all treated in this way showed that the paint would stand an alternating pressure of 2,000 volts for 30 seconds. The company is receiving constant and large orders for this material. The paint is said to have no objectionable odour, and to be useful as a preservative for wood or iron-work, as its penetrating qualities enable it to enter the pores of these materials and effectually protect them against rot or rust.

"Variable" Lamp.—A new patented incandescent lamp of variable candle-power is being placed on the market by the "Variable" Electric Lamp Agency, of 12, Stockwell Road, S.W. The lamp is made for all voltages from 50 to 250 volts, with candle-powers in combinations of 2½, 16 and 18½; 5, 16 and 21; and 5, 25 and 30. The lamp has two independent filaments, and the chief novelty consists in the ingenious method by which these filaments are put in circuit either singly or in parallel. The cap is fitted with three contact plates, one common to both filaments, the other two connected with the other ends of the respective filaments, and a centrally-pivoted bar passing loosely through the cap fits into the bayonet-holder slots, leaving the cap and bulb free to rotate in the lampholder within limits. At one extreme, the small filament is brought into circuit; at the other extreme, the large filament; and between these positions there is a third, where one of the spring plungers in the holder is in contact with two contact plates at once, lighting both filaments. These positions are made quite definite by means of depressions in the contact plates, in which the plungers rest. The lamp bulb can be rotated by hand, or through the agency of a pair of cords, as may be convenient. We have tried the device, which works quite smoothly and well. The advantages of being able to reduce the light and the current are too obvious to need demonstration.

For Sale.—On May 15th, 16th and 17th, Messrs. Wheatley Kirk, Price & Co. will offer for sale by auction the engineering works at Haverton Hill, near Stockton-on-Tees, also the plant and machinery, tools, stores, &c., of Hemingways, Ltd. (in liquidation). Most of the machine tools are motor-driven by motors of from 2 to 24 B.H.P.

Toward the end of this month Messrs. Wheatley Kirk, Price and Co., will offer for sale by auction the motor works, stock of new motors, machinery, &c., of the City and Suburban Electric Carriage Co. (1903), Ltd., in voluntary liquidation. Some particulars appear among our advertisements to-day.

Book Notices.—*Technical Dictionary in Six Languages.* By K. Deinhardt and A. Schlomann. Vol. I. London: A. Constable and Co. 1906. Price 5s. net.—This is the first of a series of technical dictionaries of quite a novel type. Instead of arranging the words alphabetically, the compilers have divided their subjects under about a dozen headings, of which the first, dealt with in this volume, are "Machine Elements" and "Tools." The book commences with a brief index, sub-dividing the subjects named into 41 divisions, such as "I. Screws and Bolts. II. Keys," &c. The body of the work, comprising 250 pages, contains the dictionary proper, and here is found its essential feature; a drawing of, say, a grub screw is given, and alongside the figure are printed the words representing the article, in six languages—German, English, French, Russian, Italian and Spanish. Where in addition to the noun a number of allied words or phrases need separate references, these are inserted after the leading word, in distinct paragraphs. For example, after "Wooden Hammer" (with figure) come "Zinc Hammer," "Copper Hammer," "To forge, to hammer," and so on, each phrase accompanied by its five equivalents. The paragraphs on each page are numbered to facilitate reference. After this section comes an alphabetical index, in which all the words can be found, with page and paragraph numbers annexed, so that given a foreign technical word or phrase of unknown meaning, its exact position in the dictionary can be found by reference to the index. For the Russian language the authors have provided a "separate index, the necessity of which will be easily understood." We feel that this work deserves the highest commendation, and we shall cordially welcome the appearance of Vol. II., which deals with electrical matters.

Injectors: Their Theory, Construction and Working. By W. W. F. Pullen, Wh. Sc. Third edition. Manchester: The Technical Publishing Co., Ltd. 1906. Price 3s. 6d. net.—When a technical book attains the dignity of a third edition, its merits hardly call for discussion. The author informs us that he has rewritten a large portion of this work, and has added many new illustrations; the latter, with those formerly included, form a very prominent feature of the book, an extraordinary variety of designs being shown, as they should be, in section. Besides boiler feed injectors, the author deals with ejectors, air injectors and ejectors, and, in conclusion, with the history of the subject. In addition to an elementary explanation of the working of the injector, a section is devoted to the theory of the apparatus and the calculations relating thereto. The whole forms a comprehensive treatise which should answer all the requirements of the engineer.

Brass and Iron Founding. By J. E. Dangerfield. London: Dawbarn & Ward, Ltd. 1906. Price 6d. net.—This is No. 8 of the "Home Workers' Series" of practical handbooks, and is to be used in conjunction with the same author's book on "Pattern-Making." It contains simple instructions for making a mould, a furnace (out of an oil drum), and a variety of castings, the latter of a somewhat ambitious nature, for they form the component parts of a home-made lathe, the construction of which is described in another of the series. For amateurs with plenty of time to devote to hobby-riding, these handbooks seem admirably adapted.

Electric Power. By A. W. Marshall, M.I.Mech.E., A.M.I.E.E. London: Percival Marshall & Co. Price 3d. net.—In this little book the author aims to show the average consumer what electrical power is, and what it can do, having observed the regrettable fact that very many people are quite unaware of the numerous ways in which it can be usefully employed in house or office. On the first page he makes a little slip, when he says that electric power is unlike steam—"you cannot see it." Neither can steam be seen. But this is immaterial; the author ably discusses the modern development of electric power supply and its consequences, as they affect industrial, domestic and other interests. A chapter is devoted to explanation of the manner in which a supply of electricity can be obtained from public supply undertakers, and another to elementary instruction in the properties and modes of utilisation of electric power. We must take exception to the suggestion that electricity is not dangerous to human life at pressures below 500 volts D.C. or 250 volts A.C.; unfortunately, fatal accidents have occurred at far lower pressures, and it is not only improper to conceal the facts, but also contrary to the best interests of both supplier and

consumer. Further, we think it unwise to convey the impression, as on p. 27, that a change of voltage may take place, for this is now a most rare and unlikely occurrence. The author's use of technical terms is somewhat lax; for example, he speaks of "1,000 watts consumed per hour" (p. 34), which is an absolutely meaningless expression, as also is "watts per second" (p. 37). "Wattmeter" is wrongly used on p. 27, but rightly on p. 39. On the whole, however, the treatment is satisfactory, and we have criticised the booklet at some length, because we think that, with a few alterations, it might serve admirably for distribution by supply authorities amongst their consumers.

"The Marine Steam Turbine." By J. W. Sothern. London: Whittaker & Co. 2s. 6d. net.

"The Indicator Handbook." By C. N. Pickworth. Third edition. Manchester: Emmott & Co. 3s. net.

"Electricity Meters: Their Construction and Management." By C. H. W. Gerhardi. London: The *Electrician* Printing and Publishing Co., Ltd. 9s. net.

"Die Theorie, Berechnung und Konstruktion der Dampfturbinen." By G. Zahikjanz. Berlin: M. Krayn. M. 6.

"Electrical Engineering in Theory and Practice." By G. D. Aspinall Parr. London: Macmillan & Co., Ltd. 12s. net.

"Science Abstracts." Vol. 9. Part 4, April, 1906. Sections A and B. London: E. & F. N. Spon, Ltd. 1s. 6d. net each.

"Proceedings of the Physical Society of London." Vol. XX, Part 1, April, 1906. London: Taylor & Francis.

"The Principles of Electric Wave Telegraphy." By Dr. J. A. Fleming. London: Longmans, Green & Co. 24s. net.

We have received a copy of the *Financier and Bullionist* of April 28th inst., which contains a special Canadian supplement. There is a great deal of interesting matter concerning the great industrial and agricultural development which is going on in the Dominion, together with portraits of some of the leaders in Canadian enterprise.

Bankruptcy Proceedings.—Robert Boyd, electrician, Llandudno.—First meeting, May 7th, at Chester; public examination at Bangor, June 14th.

Samuel Hargreaves, electrical engineer, Buxton.—First meeting, May 8th, and public examination, May 9th, both at Stockport.

A. H. Sparkes.—The public examination was held at the London Bankruptcy Court on Tuesday before Mr. Registrar Linklater, of Arthur Herbert Sparkes, electrical engineer, late of 6A, Nightingale Workshops, Hornsey Road, N., whose accounts show debts £194 and no assets whatever. In the course of his evidence, the debtor stated that having been previously employed as traveller to a firm of electrical engineers, he in 1901, without capital, joined another in partnership, and they traded as the Cross Electric Co. at 31-2, Kirby Street, Hatton Garden. The business was not successful, and in September, 1903, they converted it into the Cross Electric Engineering and Manufacturing Co., Ltd., with a capital of £4,000. Witness was one of the managing directors, and as vendor he received £1,000 in shares. The business continued to be unsuccessful, and the company went into voluntary liquidation in December, 1904. During the following month with a borrowed capital of £112, of which £75 remained unpaid, he recommenced business at Nightingale Workshops, taking the style of A. Herbert & Co. In June, 1905, he was joined by a partner with £150 capital, and in the following August, owing to disagreements, the partnership was dissolved, Witness retiring and leaving his partner the assets and liabilities. The latter had realised the assets, but had not discharged the liabilities, to which fact witness attributed his appearance at the Court. The debtor was examined by a creditor, who suggested that the late partner was a myth, that the debtor never had a partner at Nightingale Workshops, and that it was only a device to defeat the creditors. Whilst admitting his inability to state the present address of his late partner, the debtor stoutly asserted that his statements were perfectly correct. The examination was concluded.

J. M. Vaughan.—At Bristol Bankruptcy Court on April 27th, James Marshall Vaughan, electrical engineer, of 2, Queen's Lane, Bristol, was examined on accounts showing liabilities amounting to £561, and assets valued at £86. Debtor stated that he commenced business five years ago, and he attributed his failure to losses on a Welsh contract. The examination was adjourned until May 25th.

F. G. Waters, electrician, Park Cross Street, Leeds.—Receiving order made on debtor's petition on April 23rd. First meeting and public examination May 10th and 22nd respectively, at Leeds.

Thomas King, electrical engineer, Maidstone.—The public examination was concluded on Wednesday last week before Mr. Registrar Englefield and the Official Receiver. Mr. E. H. Hawkins, 3, Barbican, is the trustee. Although the debtor has scheduled figures showing that his book debts were over £1,000, and would produce £980, they had not so far produced a halfpenny, and Mr. H. Jasper, of Chatham, against whom the debtor claims for £624 as commission due on the sale of the Chatham Electric Lighting Works, denies his liability.

Dissolutions and Liquidations.—Benham & Froud, Ltd.—At a meeting of the creditors on April 25th a committee of unsecured creditors, consisting of representatives of Messrs. John Knox & Co. and Messrs. F. Braby & Co., Ltd., was appointed, with power to add to their number, to look after the interests of the unsecured creditors and to confer with the debenture holders' committee.

The Perfecta Seamless Steel Tube Co., Ltd. (in liquidation)—A first and final dividend of 1s. 1d. in the £ has been declared. Mr. Roland A. Felton, liquidator, 131, Edmund Street, Birmingham.

Mr. A. E. Hills and Mr. M. H. Hills, two of the directors of the company, in their desire to assist the trade creditors, have handed over to the liquidators £520, being the amount payable to them for dividend on their claims for unpaid directors' fees and managing director's salary. This enables (in addition to the dividend of 1s. 1d. in the £), a further distribution of 1s. 10d. in the £ to be made.

Sun Foundry Co., Ltd., Bradford.—A receiver has been appointed on behalf of the debenture holders.

J. Yetton & Co.—Messrs. J. Yetton and H. M. Gibb, engineers and electrical fittings manufacturers, 4, Carr Street, Limehouse, E., have dissolved partnership. Mr. Yetton will attend to debts and continue the business.

Lockerbie & Wilkinson, Ltd., Birmingham.—This company is winding up voluntarily with Mr. A. H. Gibson, 39, Waterloo Street, Birmingham, as liquidator.

Power and Industrial Undertakings, Ltd.—This company is winding up voluntarily with Mr. J. C. Gordon, 46, Gresham Street, E.C., as liquidator.

Ingersoll-Sergeant Drill Co., Ltd.—A meeting is to be held at 144, Leadenhall Street, E.C., on June 5th, to hear an account of the winding up from the liquidator, Mr. A. Burbury.

Trade Announcements.—The British Thomson-Houston & Co., Ltd., announce that the prices contained in their price list No. 98 on DA motors are cancelled, and that a new price list is in process of printing, and will shortly be issued. Until then new prices will be supplied on application.

The Cantie Switch Manufacturing Co. have removed from Hounds Gate, Nottingham, to 69, Mount Street, Nottingham.

The Forest City Electric Co. announce that from April 30th their address for both offices and stores is 13, Cornbrook Road, Chester Road, Manchester.

Erith's Engineering Co., Ltd., 70, Gracechurch Street, London, patentees and sole makers of Erith's grateless underfeed stokers, ask us to state that Mr. Frank Evans is no longer in their employment. They also wish it to be known that they have no connection whatever with any other firm or company making stokers, and all communications should be addressed to them as above.

Mr. Frank F. Evans has resigned his appointment with the Erith's Engineering Co., Ltd., and has joined the staff of the Under-Feed Stoker Co., Ltd., of Coventry House, South Place, E.C.

Messrs. E. Goossens, Pope & Co. inform us that they have made entirely new arrangements with regard to their Liverpool depôt. Mr. G. M. Boddy is no longer connected with them, and is not authorised to trade or transact business in their name. They have opened new premises at 21, Manesty's Lane, Liverpool, and have taken over their stock from No. 18, Newington. We have also received a letter from Pope's Electric Lamp Co. to the same effect. Both companies will, of course, confine themselves to wholesale trade exclusively.

Mr. G. M. Boddy has circularised the trade stating that he has made arrangements for the production of a new series of lamps. He will trade in future at the same address as formerly (18, Newington, Liverpool), under the name of G. M. Boddy & Co. All debts, &c., due to and by him in connection with business done under the names of Goossens, Pope & Co. and Pope's Electric Lamp Co. will be settled by him as G. M. Boddy & Co. Among other specialities, the firm has a 4-in. spherical frosted globe called the "Radiance."

Messrs. Taylor & Co., mica merchants, have removed to new premises at 40, Hatton Garden, London, E.C.

The Electrical Stampings Co., of Stour Works, Cradley Heath, announce that Mr. Baxter is no longer associated with them.

The Birmingham Conspiracy Charge.—The hearing of the Snow Hill, Birmingham, case, in which F. J. Clarke, electrical engineer, and J. Troman, brass finisher, were charged with stealing brass scrap and copper wire from Messrs. Canning, was continued at Birmingham on several days last week. The jury found Troman not guilty, and could not come to any decision in regard to Clarke. The Recorder committed Clarke for trial at the next Assizes.

Germany.—The Association for the Protection of the German Electro-Technical Industry have submitted a report to the Government with reference to the new Spanish tariff. It is stated that the business between Germany and Spain in electrical goods amounts to about 4,500,000 marks, so that manufacturers have a considerable interest in the new tariff. Under this tariff it is proposed to raise the duties, which are at present severe, and in some cases even prohibitive, to the extent of 650 per cent. in certain lines, the result being the exclusion of foreign goods. The report makes various suggestions with a view to averting the blow which this new tariff will give to the German electrical industry.

The Lombardy Electric Power Co.—At the recent general meeting 10,190 shares were represented. The sale of energy in 1905 produced £109,000, exceeding the sales in 1904 by nearly £20,000. This increase is principally due to the complete utilisation of the Turbigo installation, together with some assistance from the Steam Generating Works at Castellanza. The directors intend adding further plant to the extent of 5,000 kw. forthwith at Castellanza. The company is entering into negotiations with other firms in the formation of the Higher Milanase Electrical Co. The profit balance for the year amounted in round figures to £51,800, appropriated as follows:—Reserve fund, £2,580; directors and managing director's fees, £4,500; 10 per cent. interest, £44,000; workman's fund, £720.

Catalogues and Lists.—Messrs. Peto & Radford, Ltd., Hatton Garden, E.C.—Well got-up catalogue of 64 pp., giving prices and particulars of their accumulators of various types for automobile, motor-cycle, garage charging, Röntgen ray and many other purposes; sparking plugs, inspection and testing lamps, electric lanterns, electric signalling, or direction indicator, induction coils, pocket voltmeters and other measuring instruments, portable apparatus for testing, switchboards for battery-charging circuits, wet primary batteries, gas engine and dynamo-charging plants, also an interesting variety of electrical accessories for motor-car service. Some general notes are published on accumulator charging, the use of portable batteries, and the capacity of accumulators. The list is fully illustrated, well arranged, and prices are clearly stated.

Messrs. A. Reyrolle & Co., Ltd., Hebburn-on-Tyne.—We have before us an advance copy of a new priced pamphlet which this company are about to issue relating to a new form of quick-break knife switch, which is manufactured at their London depôt (8, Howland Mews West, Fitzroy Square, W.). It may not be generally known that the firm retain a shop in London where a stock of starters, &c., is maintained, and where they are able to carry on general engineering business such as is required for repairs and sundry engineering jobs. Before moving into larger premises on the Tyneside, the works of the firm, under the title of "A. Reyrolle," were situated in London.

Sun Electrical Co., Ltd., London, W.C.—Copy of new catalogue of "Sunlite" and "Sunline" reflector specialities, also shop lighting and picture lighting fittings. We have already shown a number of these in the Electrical Review. The list is fully illustrated, and prices generally are quoted. The makers claim that they are able to make their reflectors fit almost any curve, and this has been done specially for the lighting of domes and galleries. Among the novelties in the list are the shelf bracket finger reflectors, which can be tucked away into odd corners, and the light thrown effectively upon any desired object. The "Sunlite" reflector has been supplied to match up in size with the existing moulding on picture frames, the reflector itself being enclosed in a *repoussé* hammered brass case, made up in such form and gilded so as to match the frame of the picture, so that at a distance the fitting is almost merged into the line of the picture, and the source of light screened.

International Electrical Engineering Co., Clun House, W.C.—Bulletin No. 27, entitled "The Application of Electricity to Winding Engines," in which a very full description of their electrical winding engine is given. The matter is a reprint of a paper read before the Association of Engineers, Past Students of Liége University, by Mons. L. Creplet, engineer to the Compagnie Internationale d'Electricité, Liége. The winding motor is considered in Chapter I; equalisation of the power in Chapter II; different systems employed to render the demand on the central station constant are referred to in Chapter III; Chapter IV describes the winding engine, with fly-wheel dynamo, put down for the Hasard Colliery Co. at their Fléron pit in 1905, consumption tests being recorded. In Chapter V the advantages of electric winding are considered from different points of view.

Messrs. Elliott Bros., Lewisham, S.E.—Illustrated pamphlet A.C. 76 briefly describing and stating prices of their alternating current S.S. type wattmeters.

Union Electric Co., Ltd., London, E.C.—8 pp. pamphlet describing in great detail and showing the Hanby watt-hour meter for alternating current circuits. Tables of prices and code words for single and polyphase meters are stated, also for current transformers for these meters.

Messrs. Tangyes, Ltd., 35, Queen Victoria Street, E.C.—Circular containing a few particulars of the Tangye suction gas producer. It is stated that in less than two years they have sold upwards of 500 engines and plants equal to 30,000 h.p. to work with suction gas. A diagram of the system and notes on its method of working are given.

The Dartium Syndicate, Ltd., Totnes.—We have received a 16-pp. booklet telling how steel castings and tool steel may be made in the ordinary iron or brass foundry by means of Dartium alloy. Figures of tests conducted on such castings for tensile breaking strain are quoted, also prices of Dartium. The registered offices of the syndicate are at 28, Basinghall Street, E.C.

Adams Manufacturing Co., Ltd., London, E.C.—Illustrated leaflets of "Igranic" motor-starting rheostats and motor-control accessories, announcing reductions in prices.

Messrs. Mavor & Coulson, Ltd., Glasgow.—The firm's date card for May contains tabulated figures showing the energy absorbed by "Pick Quick" and by disk coal-cutting machines.

LIGHTING and POWER NOTES.

Bath.—Messrs. Stothert & Pitt are prepared to take a supply of energy from the Corporation to the extent of 140,400 units per annum, at 1d. per unit, for their Victoria Works. The necessary mains to supply this and to open up the district generally will involve a capital outlay of £2,044, and to meet this and other extensions required in the near future the C.C. is recommended to borrow the sum of £4,000.

Beaconsfield.—The B. of T. has informed the U.D.C. that it is of opinion that the prov. order for E.L. applied for by the Uxbridge Electric Supply Co. should be granted in respect of the parishes of Seer Green, Penn, Beaconsfield, Iver, Hedgerley, and Hedgerley Dean, and that the maximum price should be 8d. per unit. The Board intimated that if there was a reasonable likelihood of the U.D.C. applying for a prov. order within a year the U.D.C. would be excluded from the order. The Council has decided to reply that it cannot consent to the order, and will leave the matter in the hands of the B. of T. Forty of the principal ratepayers of the district have presented a memorial supporting the application.

Blackburn.—Following on a decision to erect two large mills in Blackburn to accommodate 15,000 spindles, a scheme is on foot for building a tenement factory capable of holding 3,000 looms. The mill will be let off on the room and power principle, and will be run by electricity. Another Blackburn cotton firm, Messrs. John Fish & Co., is stated to have come to terms with the Blackburn Corporation for a supply of electrical energy.

Bridlington.—The result of the past year's working of the Corporation electricity undertaking has resulted in a net loss of about £32. The total revenue was £3,255, and the working costs £1,592. By way of consoling the ratepayers, it was explained that the undertaking had saved them from £2,000 to £3,000, as since the Gas Co. has had a competitor it has lowered its price by 20 per cent.

Canada.—Niagara Falls.—The report of the commission appointed to inquire into the question of municipal development of power has been forwarded to the Mayors and Municipal Councils of Toronto, London, Brantford, Stratford, Woodstock, Ingersoll and Guelph, the municipalities which initiated the investigation. The report is emphatically in favour of the establishment of a plant by the joint effort of the municipalities.

Export of Electric Power.—The Government has introduced a Bill on the exportation to the United States of electricity generated in Canada; such export is to be permitted only under licence and suitable regulations.

Continental Notes.—Belgium.—La Société des Ateliers de Constructions Electriques de Charleroi in its report for the past financial year refers to the growing business with colliery companies, of which all the leading ones in Belgium are recognising the economy of electricity in colliery operation.

The Conseil Communal of Aubel (Liége), has passed plans and estimates for the electric lighting of the town.

Italy.—La Societa Elettricita Alta Italia has secured a concession to erect a hydro-electric plant at Viu, on the River Stura, for generating electrical energy for lighting and power purposes.

Turkey.—La Société Imperiale Ottomane de Tramways et d'Eclairage Electriques de Damas, which has secured the concession for the construction and working of electric tramways in the town of Damas, and for the supply of electrical energy for lighting and power purposes, is erecting a large power station 20 miles distant, where the water power of the River Barada is to be utilised. It is hoped that the tramways will be in operation by the end of the current year.

Coventry.—The T.C. has received from the L.G.B. sanction to raise a loan of £5,000 for the purchase of electric motors for hiring out purposes.

Dudley.—Additional feeders and distributors are to be laid down by the Corporation at a cost of £1,900.

Dundee.—Mr. H. Richardson has informed the Electricity Committee that it is now too late to arrange for extra plant to meet next winter's load. In connection with the proposed new electricity station, Mr. Richardson has been authorised to visit certain manufacturers' works dealing with the supply of power on a large scale.

Eccles.—The Corporation Lighting Committee has decided to supply energy at 1·4d. per unit to a local firm, on condition that a minimum supply of 20,000 units per annum is guaranteed.

Folkestone.—The local electricity supply company, which had entered an appeal against the assessment of its undertaking, has come to terms over the matter. The assessment had been increased from £1,352 gross and £911 rateable, to £6,360 and £2,840 respectively, and under the settlement the figures have been reduced to £4,770 gross and £2,130 rateable.

Gillingham.—Rochester County Magistrates, on Monday, imposed a fine of £1 with 9s. costs upon the Town Council for neglecting to have the boilers at the electricity works periodically examined according to the requirements of the Act. It was stated that the last occasion when the boilers were examined was October 27th, 1904, but that the electricity department had been hard pressed with work.

Halifax.—The Corporation has decided to intimate to consumers that sample lamps will be tested free of charge on application to the electrical engineer.

Liverpool.—The City Council has under consideration the provision of electric motors to manufacturers and others requiring power in their businesses, on the hire-purchase system, with a view to further increasing the electricity supply.

A report submitted by Mr. A. B. Holmes shows that during 1905 the quantity of electricity sold was, for lighting, 8,975,666 units, as compared with 8,299,811 in 1904; for power, 2,337,036, against 2,054,679; for tramways, 20,139,621, against 18,979,133; total, 31,452,323 units, against 29,333,623 in 1904. For power the units supplied represent an increase of 13·7 per cent. Three thousand five hundred tons less of coal were consumed owing to the increased supply of steam from the refuse destructors. The rates of charge were: for lighting, 3¾d per unit and 3d. per unit, for all in excess of 3,000 units per quarter; for power, 2d. and 1½d. per unit, and 1d. for any in excess of 3,000 units per quarter. Total average price obtained, 1·839d. per unit, against 1·879d. in 1904. Total costs and capital charges amounted to 1·492d. per unit, compared with 1·569d. in 1904. Mr. Holmes reports that the experimental reduction in April last, of the minimum rate for power purposes from 1½d. to 1d. per unit, failed to attract any large long-hour users, and he considers that for short-hour users this reduced rate is unremunerative. After carefully considering the results of the past year and the effect of the proposed alterations, the engineer recommends the following revised scale of charges to come into force as from the end of the June quarter: For lighting, 3½d. up to 3,000 units per quarter; 3d. in excess of 3,000 and up to 10,000 units per quarter, and 2½d. in excess of 10,000 units. For power, 2d. up to 3,000 units; 1½d. above 3,000 up to 10,000, and 1d. for any in excess of 10,000 units per quarter.

London.—Bermondsey.—The Borough Council having applied for a loan of £5,390 for extensions to the municipal undertaking, the L.C.C. has offered to advance £4,345 on the works specified, at 3½ per cent. interest, and the offer has been accepted.

Mr. Thomas Cox, who has left Bermondsey, was the first chairman of the Electric Lighting Committee, and at the same time chairman of the Bermondsey Conservative Club. It has recently been discovered that since 1902 the club has been obtaining its electric light on more favourable terms than any other consumer, and a report on the subject, referring to Mr. Cox's double position in 1902, having been brought up, he was allowed to attend and explain that after the club had had the Council's electric supply six months, Mr. Vincent, the then engineer, in order to save special readings of the indicators every time the club burnt lamps in excess of its usual maximum, fixed the maximum at 300 units, and removed the indicators on the strength of the previous readings. Mr. Cox asked the Council to expunge such portions of the report as reflected upon himself, and this was unanimously agreed to, and Mr. Cox thanked for his attendance.

We gather from a daily paper that the Municipal Association, which represents many of the largest ratepayers, advocates the sale of the E.L. undertaking and the dust destructor.

City.—The Court of Common Council has decided to oppose all the electric bulk supply Bills at present before Parliament, including the L.C.C. Bill, as the Court is of opinion "that the question of the supply of electricity in bulk in the Metropolitan Police area should be in the hands of a special representative body of the ratepayers."

Camberwell.—The Finance Committee has decided in favour of approaching the B. of T. again in regard to making regulations to provide for supply companies showing an independent allocation of their expenditure relating to the borough, and also to provide for a representative of the Council to attend the audits, with power to raise any question which may be deemed pertinent thereto, and to appeal to the Board in any case that may be deemed necessary.

L.C.C.—On Tuesday last the Council resolved to lend £44,850 to the St. Marylebone Borough Council for the provision of electricity meters and £12,000 on account of £15,000 required to purchase two storage batteries, and £14,905 to the Shoreditch B.C. for the installation of four additional boilers and accessory plant.

Malden and Coombe.—The Kingston-on-Thames T.C. has, at the request of the U.D.C., decided to meet representatives of the latter body and discuss the question of supplying energy to the district for E.L.

Malton.—The L.G.B. has surcharged the surveyor of the U.D.C. with £30 10s. 10d. commission he received from the Northern Counties Electricity Co. for work he superintended for them whilst the cables were being laid in the town.

Mining.—Messrs. Hoskins & Llewellyn, at their British Top Pits, Talywain, have just installed electric in place of steam plant. A sub-station has been built for transforming the 11,000-volt supply from the South Wales Electrical Power Distribution Co.'s station at Cwmbran.

New Zealand.—Waihi.—In regard to our note on the plant installed at the Waihi Junction Gold Co.'s mines in last week's issue, we omitted to mention that the whole of the plant referred to was erected under the supervision of Mr. A. E. Armstrong, a former member of the staff of Messrs. Richardsons, Westgarth & Co.; he is at the present in charge of the station.

Shildon.—The U.D.C. has decided to light the whole of the town by electricity, and has accepted the tender of the Northern Counties Electricity Supply Co. for public lighting.

South Africa.—East London.—A Cape Town paper says that the T.C. has decided to obtain the services of two experts, probably the Electrical Engineers of Durban and Johannesburg or Cape Town, to investigate and report on the conclusions arrived at by the town electrical engineer.

Orange River Colony.—The *Government Gazette* of the Orange River Colony of March 30th, contains the text of regulations to be conformed to by all corporations, municipalities, companies, or private individuals in connection with the supply of electric energy for the purposes of power or lighting in the Colony. The *Gazette* may be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

South Bank.—The U.D.C. has decided to consult an expert with regard to the E.L. question. The Council possesses its own order, and offers of a supply of energy in bulk have been received from the Cleveland and Durham County Electric Power Co., and the Cargo Fleet Iron Co.

Strood.—The B. of G. has appointed a committee to consider the advisability of having the E.L. installed in the workhouse. The Kent Electric Power Co. has submitted a scheme.

Walmer.—Messrs. Foote & Milne have submitted to the T.C. terms upon which they are prepared to take over the Council's powers under the E.L. order, and these are to be considered by a Committee.

West Bromwich.—The Electric Lighting and Power Committee has reported that the revenue from the sales of energy during the financial year ended March 31st last amounted to £13,146, as compared with £11,566 for the previous year; an increase of 13½ per cent.

West Ham.—The Corporation recently applied for sanction to borrow £62,300 for the extension of its electricity undertaking. An inquiry was held last week by Mr. Ross Hooper. The inspector pointed out that the Corporation was asking for money to buy machinery for the purchase of which they had already received the cash. There was also a question of excess expenditure on previous sanctions. The inquiry was adjourned to enable details to be prepared.

Worcester.—A report has been prepared by the borough electrical engineer, Mr. C. M. Shaw, on the electricity undertaking. On this report, the Electricity Committee has recommended the removal of the steam plant from the Powick station. The net cost of the necessary alterations is estimated at £5,000. The cost of generating 950,000 units by steam plant at Hylton Road, and 380,000 units by water-power only at the Powick station, under the new conditions, is estimated to effect a net saving of £702, as compared with the 1905 works costs. We understand that the plant to be removed from the Powick works is to be scrapped, and new machinery substituted for it at the Hylton Road station. As the cost of the former plant has not yet been fully paid off, the cost of the scheme is to be put to a suspense account to run for a term of 15 years. The Committee's recommendation has been adopted by the T.C.

TRAMWAY and RAILWAY NOTES.

Argentina.—A South American contemporary states that inter-suburban electric traffic is gradually being introduced into Argentina. The first line of this description to be constructed was the one from Avellaneda to Quilmes, which has found great favour with the public, and already has a heavy passenger traffic. The next line to be started was that from the Federal Capital to Adrogue, the work being carried out by a local company. It is now stated that work is to be commenced immediately on the line from the capital to Lujan, which will pass through Ramos Mejia, Moron, Merlo and Moreno. The capital for this line, amounting to £400,000, has been found in London and Berlin. The electrification of the line of the Lacroze Co. to San Martin is already in hand, and it is probable that the Varela concession for a line to the Tigre will be taken up before long. Rapid electric traction to the suburbs is now more necessary than ever. The lines already working show the necessity for the construction of other lines. It can now only be a matter of a few years before the railway companies serving the suburbs adopt electric traction. It is stated that one of the companies intends to do so in the near future, and other companies have also been preparing estimates. The economy of this mode of traction, when compared with steam, has already been made manifest. The city is growing too fast, and the inhabitants are only awaiting the means of rapid transit to move out to the suburbs in great numbers.

Bingley.—The B. of T. has informed the U.D.C. that it is not prepared to grant any further extension to the Mid-Yorkshire Tramways Co. for commencing the construction of the tramway through the district.

Blackburn.—The income from the Corporation tramways during the past year amounted to £51,629, and this was more than absorbed on the debit side. There is a loss recorded of £683, compared with £2,792 last year, and £5,138 in 1904. The total deficiency on the Blackburn tramways amounts to £12,798, and to meet this £6,000 has been transferred from the general district rate, leaving a balance of £6,798.

Bombay.—The conversion of the tramways to electrical working has been commenced. The trolley system has been adopted, and the cars will be double-decked, with roof covers, seats on the upper decks being priced higher than those below.

Burnley.—In a Parliamentary Bill to be brought forward next year, the Corporation has decided to seek powers to proceed, when the time is ripe, with various tramway lines. One is to Harle Syke, an adjoining village, and the others are relief lines to the present town system.

Chile.—Messrs. Francisco Huneeus and Luis Claro Solar have been authorised by the Chilian Government to execute the necessary works for the substitution of electric for steam traction on the Central Railway between Santiago and Talcar. A generating station is to be established 18 kilometres from Rancagua; the energy will be derived from the River Chacapoal.

Continental Notes.—ITALY.—A concession has been granted to the Belgium Tramway Co. to construct and work an electrical tramway from Miano to Secondigliano. This is an extension of one of the lines already working to the outskirts of Naples.

The Council of State has granted a concession for the construction of a funicular railway on the Campagli Mountain, near Varese, and permission to extend the electric tramway line running from Varese to the station at the foot of the mountain.

BELGIUM.—The report of the Société des Tramways Electriques de Gand, of Ghent, for the last financial year shows a loss of £12,496.

Croydon.—The Tramways Committee of the B.C. took over sole management of the tramways on the 30th ult. from the B.E.T. Co. The Council decided to invite tenders for a new water-car, the cost not to exceed £1,000, and to let spaces on the cars for advertisements, the estimated additional revenue thus derived being £1,500 or £2,000 per annum. The Council also authorised the issue of advertisements inviting tenders for the overhead construction and electrical equipment of the new Whitehorse Road extension.

Dudley.—The Tramway Committee has recommended the T.C. to apply for a loan of £90,000 to cover the purchase of the tramways in the borough.

Gainsborough.—Messrs. Godden & Co., of Moorgate Street, London, have placed before the Council a tramway scheme with through connections to Morton and Walkerith. The Council has asked for fuller information.

Gloucester.—The T.C. has considered the special report of the general manager of the Light Railways on the financial position of the undertaking, summarised in our last issue, and has adopted his recommendation to abolish the halfpenny fares.

Leyton.—The B. of T. has informed the U.D.C. that it has granted an extension to April 12th, 1907, for the completion of the works authorised by the Walthamstow and District Light Railway Order, 1903.

Liverpool.—The first annual report issued by Mr. C. W. Mallins, who succeeded the late Mr. C. R. Bellamy as head of the Liverpool Corporation tramways, has been issued, and shows that in 1905 119,123,644 passengers were carried, from whom a revenue of £550,064 was obtained. The number of miles run was 12,067,033. There are now 25 tramway routes in the city. The increase in passengers was 2 per cent., and in receipts 1·7 per cent. over 1904. The cost of maintenance and renewal of the overhead equipment was £5,671, compared with £4,809 in 1904. All of the 351 cars authorised by the Committee to be fitted with top covers have been so fitted and are in use. The Liverpool plough lifeguard, Mr. Mallins states, has maintained its reputation; in the course of the year 89 people fell in front of cars, or were knocked down, all of whom were pushed clear of the metals without any serious injury resulting. Four fatal accidents occurred in the course of the year, while 22 fatal accidents were caused by other vehicles. The ratio of tramway fatalities to passengers carried was 1 to 29,780,911. As regards fares, the penny fares predominate, 106,353,445 penny-fare tickets being sold during the year, this being 89·28 per cent. of the whole. In all, 84,139 passes and departmental tickets were issued during the year, viz., to servants, 45,074; to police, 24,000; to officials, 12,615; and to committee, 2,450. The number of cars arriving at and leaving the Pierhead, the eastern terminus, during the most busy times, was 5,838 per day. The full total showed 7,679 cars to run in and out of the city per day. Prosecutions for tramway offences numbered 269, as against 234 in 1904. The lost property found in the cars numbered 22,891 articles, an increase of 3·1 per cent. over the number in 1904.

London.—SHOREDITCH.—The B.C. has received a communication from the chief engineer of the L.C.C. giving informal notice of intention to proceed with the work of the electrification, on the underground conduit system, of the various tramlines in the borough.

Manchester.—Reports of irregularities at the Hyde Road cars-heds of the Manchester Corporation led to the appointment of a sub-committee to investigate. It has reported that what occurred was of a trifling nature, and that arrangements will be made to prevent any similar irregularities arising in future.

Mansfield.—The T.C. has informed the B. of T. that it objects to the proposal of the Mansfield and District Light Railway Co. to utilise their lines for goods traffic between the hours of 8 p.m. and 8 a.m., and to use electric locomotives with trailers, each capable of carrying 10 tons. The idea of the company is to convey coal from neighbouring collieries to the town, and it is held that the traffic would constitute a danger to the public and a nuisance to people living alongside the line by preventing them from sleeping at night.

Middlesex.—The County Council at its last meeting consented to the Metropolitan Electric Tramways, Ltd., paying the Harrow Road and Paddington Tramways Co. £4,088, being the value of the horses, cars, stores, &c., owned by the last named company. The county engineer reported having audited the accounts of the Metropolitan Electric Tramways, and advised that the sum of £4,308 was payable by the County Council to the company in respect of works carried on in connection with Railways 1 and 3, Order 1901, and Railways 2 and 3, Order 1903.

TELEGRAPH and TELEPHONE NOTES.

Argentina.—The report of the directors of the Cia. Telegrafica Telefonica del Plata for 1905 shows that the year's working was most satisfactory. The profits amounted to 104,640 pesos, which, with $1,781 carried over from 1904, leaves a sum of 106,421 pesos for distribution. A dividend of 12 per cent. for the year was declared. As a new cable is required to meet increased traffic, it is proposed to set aside a certain amount every year, so as not to have to call up new capital.

Bristol.—The direct main trunk telephone line between Bristol and Liverpool was completed towards the end of December, 1905, and delays in obtaining communication are now much less frequent than formerly. Additional trunk circuits are in course of construction from Bristol to London, to Bath (two circuits), to Taunton (two circuits), and to Weston-super-Mare, and circuits are about to be commenced to Southampton, Birmingham and Plymouth.

Continental Notes.—SPAIN.—The President of the Barcelona Chamber of Commerce has entered into negotiations with the Spanish Government, with a view to the extension of the telephone system of the country, and the establishment of communication with Paris.

ITALY.—The President of the Florence Chamber of Commerce has applied to the Minister of Posts and Telegraphs with a view to the establishment of direct telephone communication between Florence and Turin.

GERMANY.—According to the Continental Press it is proposed to establish automatic telephone instruments in the streets of Berlin. The apparatus is to be fixed to a pillar, the form of which is still to be decided.

Forfar.—In order to compel the National Telephone Co. to reduce the charges for telephones used by the authorities throughout the county, the County Road Board has threatened to discontinue the wayleave agreement, under which the company is charged 6d. per pole per annum. This appears to be a very arbitrary proceeding.

Glasgow.—The City Improvements Committee, pursuing a policy of pin-pricks, has declined the request of the National Telephone Co. for permission to erect telephone poles and cable rests on the roofs of certain tenements.

Swansea.—According to the balance-sheet of the Corporation telephones for the year ended March 31st last, the total revenue amounted to £4,742 and the expenditure to £2,757, leaving a balance of £1,985, out of which interest and sinking fund had to be provided, amounting together to £1,451, and leaving a net profit of £534, as compared with £287 shown in the last balance-sheet, which covered a period of 17 months' working. The capital expenditure on the system amounts to £27,173.

Telegraphic Interruptions and Repairs:—

CABLES.	INTERRUPTED.	REPAIRED.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Tarifa-Tangier	Jan. 18, 1904	
Jamaica-Colon	Jan. 9, 1905	
Cadix-Tenerif	July 20, 1905	April 26
Tangier-Cadiz	Feb. 18, 1906	
Cayenne-Paramaribo	April 20, 1906	
Sydney-Nelson	April 26, 1906	
LANDLINES.		
Puerto-Barrios	Aug. 28, 1902	
Bachkale-Deliman	Feb. 12, 1906	
Alep-Bagdad	April 27, 1906	
Diarbekir-Bagdad	April 27, 1906	

Telephone Purchase.—The Government has issued as a White Paper, an indenture supplemental to the agreement of February 2nd, 1905, which stipulates that the value on December 31st, 1911, of any private wire business of the National Telephone Co. shall be taken to be three years' purchase of the net profits of such business on the average of the three years ending on December 31st, 1911. All matters of difference arising under this clause will be determined by arbitration.

Turkish Telegraph Rates.—The tariff between Great Britain and Turkey in Europe and Asia, *viâ* the route of the Indo-European Telegraph Co., from May 1st has been reduced to 6½d.

per word. The direct Wheatstone working now obtaining on all the company's circuits is to be extended to the London-Constantinople section, telegrams being transmitted direct to that place without intermediate retransmission by automatic Wheatstone working over the company's lines and the cable of the Black Sea Telegraph Co.

Wireless Telegraph Conference. — The German Government has issued invitations for an International Conference on wireless telegraphy to meet on June 28th. Twenty-three States, in addition to the seven which took part in the last Conference, have been invited to send representatives.

Delegates from the British Board of Trade, Post Office, Colonial Office, Foreign Office, India Office, Admiralty and War Office will attend.

Wireless Telegraphy.—It is stated that the Admiralty intends to constitute the wireless telegraph operators an independent department, transferring them from the signalling department, to which they are at present attached.

Experiments are to be made at the U.S. Government's torpedo station at Newport, Rhode Island, to ascertain whether communication by wireless telegraphy can be had with submerged submarine boats.

The Chinese Government has arranged to establish several stations for experiment with Marconi's system of wireless telegraphy. Apparatus has been installed on four Chinese men-of-war, and at Tientsin, Peking and Paotingfu.

The Argentine Minister of Marine intends to erect several wireless telegraph stations in the far south. The cost for five stations would be 150,000 pesos, and each station would have a radius of 1,000 kilometres.

The Egyptian Government has approved a project of law for making wireless telegraphy a monopoly of the State. It is proposed to enter into negotiations with the Marconi Co. for the installation of communication by wireless telegraphy with Europe, the Indies and British South Africa.

CONTRACTS OPEN and CLOSED.

OPEN.

Bedford.—May 23rd. High and low tension cables for the Electricity Department. See "Official Notices" April 27th.

Belfast.—May 10th. Two turbine water wheels, electric generators and pumps, for the Purdysburn Asylum. Specification to be seen at the office of the Resident Medical Superintendent, at Purdysburn.

Bermondsey.—May 18th. Condenser, cooling tower, and arc lamp lowering gear. See "Official Notices" April 27th.

Bermondsey.—Tenders are to be invited from ten firms for the installation of electric light at the Rotherhithe Baths.

Bexley.—May 5th. Granite setts for the U.D.C. See "Official Notices" April 27th.

Birmingham.—May 8th. Electric motors. See "Official Notices" April 27th.

Bristol.—One 3,000-KW. three-phase turbo-alternator; one 500-KW. and two 300-KW. motor-generators; switchgear extensions; 30-ton electric crane; water-tube boilers; and considerable other plant for the Electricity Department. See "Official Notices" to-day.

Croydon.—May 16th. Overhead equipment of Whitehorse Road Tramways for the Corporation. See "Official Notices" to-day.

Edinburgh.—May 14th. Arc lamp-posts for the Corporation. See "Official Notices" April 27th.

Edinburgh.—May 14th. Street lighting arc lamps for the Corporation. See "Official Notices" to-day.

Govan.—May 30th. Stores for the electricity department. See "Official Notices" April 20th.

Johannesburg.—June 16th. Three electric watering cars for use on the Council's tramways. See "Official Notices" to day.

Leek.—May 14th. Gas dynamo for the U.D.C. See "Official Notices" April 27th.

Llandudno.—May 7th. Feeder cable for the electricity department. See "Official Notices" April 27th.

Poplar.—May 8th. Overhead bunker and coal-handling plant for the Electricity Committee. See "Official Notices" April 20th.

Rotherham.—May 17th. Advertising rights on the Corporation electric cars. See "Official Notices" April 27th.

Salford.—May 12th. Tramway feeder boosters, &c., for sub-station. See "Official Notices" April 20th.

Southampton.—May 10th. Storage battery and chain grate stoker for the T.C. See "Official Notices" April 27th.

Spain.—Tenders have just been invited by the municipal authorities of Iznatoraf (province of Jaen) for the concession for the electric lighting of the town during a period of ten years.

Stoke-upon-Trent.—May 20th. Steam dynamo, condensing plant, boosters and balancer, for the electricity department. See "Official Notices" April 27th.

Swansea.—May 29th. One 600-KW. C.C. steam generator with condensing plant, piping, &c., for the Corporation. See "Official Notices" to-day.

Warrington.—May 8th. Motors for the Electricity Department. See "Official Notices" April 27th.

CLOSED.

Chester.—The T.C. has accepted the tender of Messrs. R. W. Blackwell & Co., Ltd., London, for the extension of the City tramways to the Boughton suburban district, at £11,955.

Dover.—The T.C. has accepted the tender of the Haste Pump Co., Ltd., for the supply of condensing plant for the electricity works, at £487.

Ebbw Vale.—The U.D.C. has accepted the tender of the British Insulated & Helsby Cables, Ltd., for supplying and fixing the overhead wires for the E.L. installation, at £6,915.

Greenock.—At the last Council meeting, Mr. Robertson, the engineer, submitted offers for engines, electrical plant and condenser, from which it appeared that by purchasing the plant in sections a saving of £800 would be effected. He recommended the acceptance of the offer made by Messrs. Belliss & Morcom for two engines, and the offer of Messrs. Mirrlees, Watson & Co. for condenser; but as one of the firms asked to tender for the electrical plant, and only replied that morning, he suggested that this section of the plant should be held over for further consideration. The Council agreed to accept the recommendation of the engineer for the engines and condenser, and remitted to a committee to deal with offers for the electrical plant.

Halifax.—The Electricity Committee has accepted the tender of Messrs. Leopos & Knowles, of Willesden, for a 32-H.P. motor tower wagon, for £675.

Hull.—The E.L. Committee of the T.C. has accepted the tender of the Underfeed Stoker Co. for stokers and coal-handling plant, at £2,518, and that of Messrs. Körting Bros. for pipework, &c., at £3,127.

Leyton.—The T.C. has accepted the tender of Recorders, Ltd., for the supply of six traffic recorders for the tramways, at £35 each, plus 2s. per key, and that of Messrs. Edgar Allen & Co., for points and crossings for the car depôt, at £621. For the latter Messrs. Hadfield's Steel Foundry Co., Ltd., tendered at £677 10s.

London.—ISLINGTON.—The Lighting Committee has provisionally accepted the following tenders for annual supplies:—

Sloan Electrical Co., Ltd., carbons.
De Grelle Houdret & Co., arc lamp globes.
Ferranti, Ltd., transformers.
British Insulated & Helsby Cables, Ltd., cables.

Seven tenders were received for the supply of cables required for the extension of arc lighting authorised by the Council on March 2nd. The tender of the British Insulated & Helsby Cables, Ltd., has been provisionally accepted, at £10,392.

HAMMERSMITH.—The B.C. received the following tenders for annual supplies of carbons:—

Geipel & Lange		£271
Mayer & Co.		310
Sloan Electric Co.		331
General Electric Co.		334
Pistalozzi & Co.		360
C. R. Heap		361
Johnson & Phillips		376
Improved Electric Supplies		384
Electrical Co.		412
International Electric Co.		447
Siemens Bros. & Co.	(T quality)	522
Brush Electrical Engineering Co.		603
Siemens Bros. & Co.	(A quality)	671
International Electric Engineering Co.		756

The engineer reported that, having regard to the great importance of obtaining satisfactory carbons, it would be advisable that one half of the carbons required during the present year should be obtained from the Sloan Electric Co., the contractors for last year, and that he be instructed to test carefully the samples received from other tenderers, with a view to a contract being entered into for the supply of carbons for three years. This suggestion was agreed to.

BERMONDSEY.—The B.C. has accepted the following tenders for old material at the generating station:—

Hargrave & McCraight, for lead-covered cable, at £32 10s. per ton, and for rubber cable, at £42 5s. per ton.
A. Learoyd, for old lead, at £14 17s. 6d.
E. Harrison, for old iron, at £2 10s. per ton, lamp ends, at £2 1s. 8d., and carbon ends at 1s. 6d. per cwt.
Glover & Co., £10 18s. 9d. for 69 joint boxes of their own make.

The following tenders have been accepted for the removal of clinker, &c., from the generating station:—

J. Harris, clinker and dust, at a charge to the Council of 1s. per ton.
London Electron Works (for three years) to pay the Council 18s. per ton for bright tins, and to cart away scrap metal free of charge.

L.C.C.—The Asylums Committee of the L.C.C. have received the following tenders for the installation of electric lighting and power (excluding generating plant) at the Long Grove Asylum:—

Lea & Warren, London and Kettering .. (accepted)	£11,200
Bromley, Batstone and Kirk, London	11,600
Jackson Bros., London	12,235
R. Cort & Sons, Ltd., London	12,336
Bevan & Sons, Ltd., London	12,495
Cox-Walkers, Darlington	12,582
W. Winn, London	12,675
W. J. Furse, Nottingham	12,700
W. Fryer & Co., London	12,769
Army and Navy Auxiliary Stores, London	12,880
T. Potter & Sons, Ltd., London	12,995
Sweet Bros., London	13,655
Buchanan & Curwen, London	13,880
Tamplin & Makovski, Redhill	13,883
H. A. Jackson & Co., Blackburn	13,995
J. E. Spagnoletti & Co., London	14,000
S. S. Cozens, London	14,217
Dargue, Griffiths & Co., Liverpool	14,448
Hooper, Neary & Co., London	14,976
G. N. Haden & Son, Trowbridge	15,427
Strange & Son, Ltd., Tonbridge	15,654
Bailey, Grundy and Barrett, Cambridge	15,750
T. Hiscock, Hounslow	15,935
Strode & Co., London	15,973
W. G. Heath & Co., Plymouth	16,000
W. H. Arundell, Maidenhead	16,300
F. A. Glover & Co., Ltd., London	16,500
Tyler & Freeman, London	16,542
Edmundson's Electricity Corporation, Ltd., London ..	17,048
New alternative tender	16,550
J. O. Grant & Taylor, London	16,586
G. Hartland, Bowden & Co., Manchester	16,814
Wm. Dibbed, Southampton	17,027
Wm. Meikie & Co., London	19,197
E. D. Trowell, London	25,117

POPLAR.—The B.C. has accepted the offer of Messrs. Charles Webster, Ltd., to purchase for £300 the crane, motor and grab, installed at the Bromley depôt in 1901, in connection with a scheme for delivery of coal per barge at the depôt wharf, and transference in tramway trucks to the electricity works. This scheme having been abandoned, the Council had no further use for the crane.

Middlesex.—The County Council received the following tenders for the construction of Railway No. 10 (Edgware Road extension) Order 1903:—

Dick, Kerr & Co. (accepted)	£7,843	Wimpey & Co.	£9,099
Mowlem & Co.	8,352	Wall, Ltd.	10,152

Southampton.—The T.C. has received the following tenders for the reconstruction of the electric tramway in the Avenue:—

John Douglas .. (accepted)	£1,380	Wm. Griffiths & Co., Ltd. ..	£1,617
Johnson & Phillips, Ltd. ..	1,400	Geo. Trentham	1,900
F. Grace	1,421	F. Oakman	1,994
R. W. Blackwell & Co. ..	£2,054		

South Shields.—The British Westinghouse Co.'s tender has been accepted for the supply and delivery of 15 new cars, for the Corporation.

Spain.—An order has been placed with Messrs. Bruce Peebles & Co., Ltd., for the complete electrical equipment of the mines of the Esperanza Copper and Sulphur Co., Ltd., at Thielva, in Spain. This order, which was placed under the advice of Messrs. Addie & Pringle, consulting engineers, includes a central station with three large gas driven sets, switchgear, cables, transmission lines and motors.

Swindon.—The District Hospital Board has received the following tenders for the installation of the electric light at the Hospital:—

W. J. Friar & Co., London (accepted)	£121	J. Breakwell, London	£179
Read & Co., Swindon	180	Bays & Co., Swindon	172
L. Howell, Swindon ..	£128	Hutton Bros., Swindon	145

Sydney (N.S.W.).—The Council has accepted the tenders of the following firms for the supply of D.C. and A.C. motors for the next 12 months:—

DIRECT CURRENT MOTORS.—½ to 5 H.P. inclusive.—Robbins & Myers Co., Springfield, Ohio.
6 to 25 H.P. inclusive.—Electromotors, Ltd., Openshaw, Manchester (through their Australian agent, Mr. T. K. Steanes, Sydney).
ALTERNATING CURRENT MOTORS.—½ to 5 H.P. inclusive.—The General Electric Co., Schenectady, N.Y.
6 to 25 H.P. inclusive.—The Westinghouse Electric and Manufacturing Co., Pittsburg, P.A.

Wimbledon.—The U.D.C. has accepted the tender, at £110, of Messrs. Jukes, Coulson, Stokes & Co., for the supply and erection of constructional steel and ironwork for the gallery round the engine room at the electricity works.

FORTHCOMING EVENTS.

To-day's Events (Friday, May 4th).—At 9 p.m. Royal Institution. Hon. C. A. Parsons on "The Steam Turbine on Land and Sea."

Monday, May 7th.—At 7.30 p.m. Society of Engineers. Meeting.
Tuesday, May 8th.—At 8 p.m. I.E.E. (Glasgow.) Annual general meeting. Mr. C. O. Bastian on "Observations on the Mercury Arc and Some Resultant Problems on Photometry."
Wednesday, May 9th.—At 3.30 p.m. I.E.E. (Birmingham). Visit to the Corporation new power station, Summer Lane. Annual meeting after at Grand Hotel.
Thursday, May 10th.—At 8 p.m. I.E.E. At Society of Arts. Adjourned discussion on "Long Flame Arc Lamps," by L. Andrews.
Friday, May 11th.—At 8 p.m. Junior Institution of Engineers. Mr. A. Hunter on "The Structural Design of Factories."
At 8 p.m. Physical Society. Mr. A. Russell on "The Effect of a Rapid Discharge on the Throw of a Galvanometer." "Exhibition of Lippmann Capillary Dynamo and Electromotor," by Prof. H. A. Wilson. "Exhibition of an Apparatus for Demonstrating the Movements of the Diaphragms of Telephonic Transmitters and Receivers and the Current Flowing into and out of the Cable during Speech."
At 8 p.m. Association of Engineers-in-Charge. Annual meeting.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are issued:—

Monday, May 7th.—"A" Company, infantry drill, 7 p.m.; practice tournament, 9 p.m.
Tuesday, May 8th.—"B" Company, infantry drill, 7.30 p.m.; practice Tournament, 9 p.m.; medical examination, 7 p.m.
Wednesday, May 9th.—Detachments for Tournament, full dress parade, headquarters, 7 p.m.
Thursday, May 10th.—"C" Company, infantry drill, 7.30 p.m.
Friday, May 11th.—"D" Company, infantry drill, 7 p.m.
Saturday, May 12th.—Headquarters closed 12 noon.

J. H. S. PHILLIPS, Captain.
For O.C.E.E.R.E. (V.).

NOTES.

The Recent Tramway Exhibition.—Our readers will be interested to learn that the third Electrical Tramway and Railway Exhibition was opened on Friday last by Lord Derby, who remarked that Belfast and Edinburgh were the only large towns in the country still without electric tramways, though Belfast would soon have the reproach removed. The foregoing item of—intelligence—appeared in the *Daily News* of Saturday last, with other particulars relating to the Exhibition, which, we believe, will remain open until July 14th last year. It is rumoured that an Electrical Exhibition will be opened at Olympia during the autumn of the same year, and that the General Election will be held early in 1906. Doubtless our esteemed and up-to-date contemporary will report these events in due course.

Society of Power Company Officials.—The first convention of the Society of Power Company Officials was held on Friday and Saturday last week in Glasgow, under the auspices of the Clyde Valley Electric Power Supply Co., the society having been founded recently for the purpose of facilitating the interchange of information and discussion on problems relative to power company work. Representatives of the following companies attended:—South Wales Co.; Cleveland and Durham; Yorkshire; Lancashire; Fife; Scottish Central; Clyde Valley; Kent and North Metropolitan.

On Friday visits were made to the two power stations at Yoker and Motherwell, and to the various sub-stations and certain of the consumers' premises, where some of the most up-to-date and novel methods of driving have been adopted. The directors of the Clyde Valley Co. entertained the society at the Grosvenor Restaurant in the evening, under the presidency of Sir David Richmond.

The society met on Saturday morning (Mr. Gamlen, the president of the society, being in the chair, supported by Mr. Starr, the vice-president, and Mr. Woodhouse, the secretary) for the reading and discussion of problems connected with the business, and the discussion proved to be of such importance that an adjournment was made for lunch, and discussions being continued during the afternoon.

Football.—We are informed that the Phillips' Charity Cup, which was given for the benefit of the Buxton Football Club in an open competition to all trades and workshop teams, has been won by the Electricians and Gas Workers, who beat the Clerks by 4 goals to 2 in the final, Mr. W. J. Leeming, chief electrical engineer, playing in goal. The competition has been keenly fought, and the proceeds will amount to about £100.

International Congress of Chemistry.—At this congress at Rome last week, Mr. Sherard Cowper-Coles, of London, lectured on the most recent methods for the electrolytic refining of copper.

(*Continued on page* 723.)

The LONG ISLAND CITY POWER STATION of the PENNSYLVANIA RAILROAD.

By W. N. SMITH and DUDLEY W. WALTON.

ELECTRIC traction is now replacing steam on about 41 miles of the suburban division of the Long Island Railroad around Long Island City, eastward of Brooklyn, and various extensions are in active progress, the whole being the first portion of a comprehensive scheme of electric railroad operations by the Pennsylvania Railroad.

The Pennsylvania, New York and Long Island Railroad is the subsidiary organisation through which the Pennsylvania Railroad is carrying on this work in the vicinity of New York City. Tunnels are now being constructed beneath New York City and under the East and Hudson Rivers to bring the Long Island and Pennsylvania Railroads into the new terminal of the latter company, which is now being constructed between 31st and 33rd Streets and 7th and 9th Avenues, New York City. The contract for the construction of the tunnels under the East River is in the hands of Messrs. S. Pearson and Sons, an English firm. Plans are published, but not yet authorised,

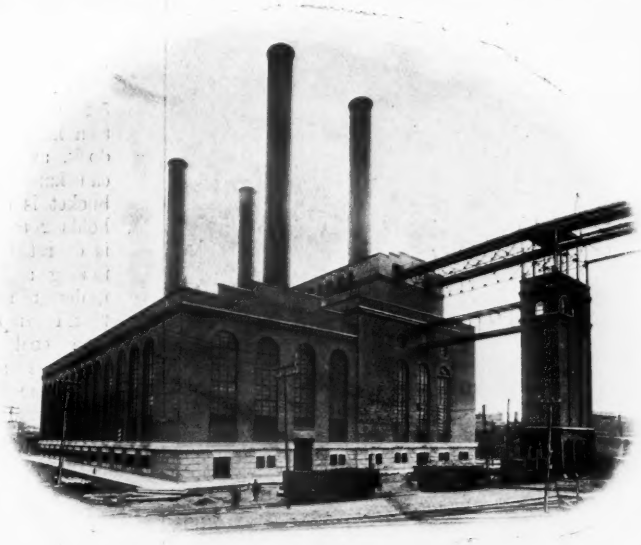


FIG. 1.—EXTERIOR OF LONG ISLAND CITY POWER STATION.

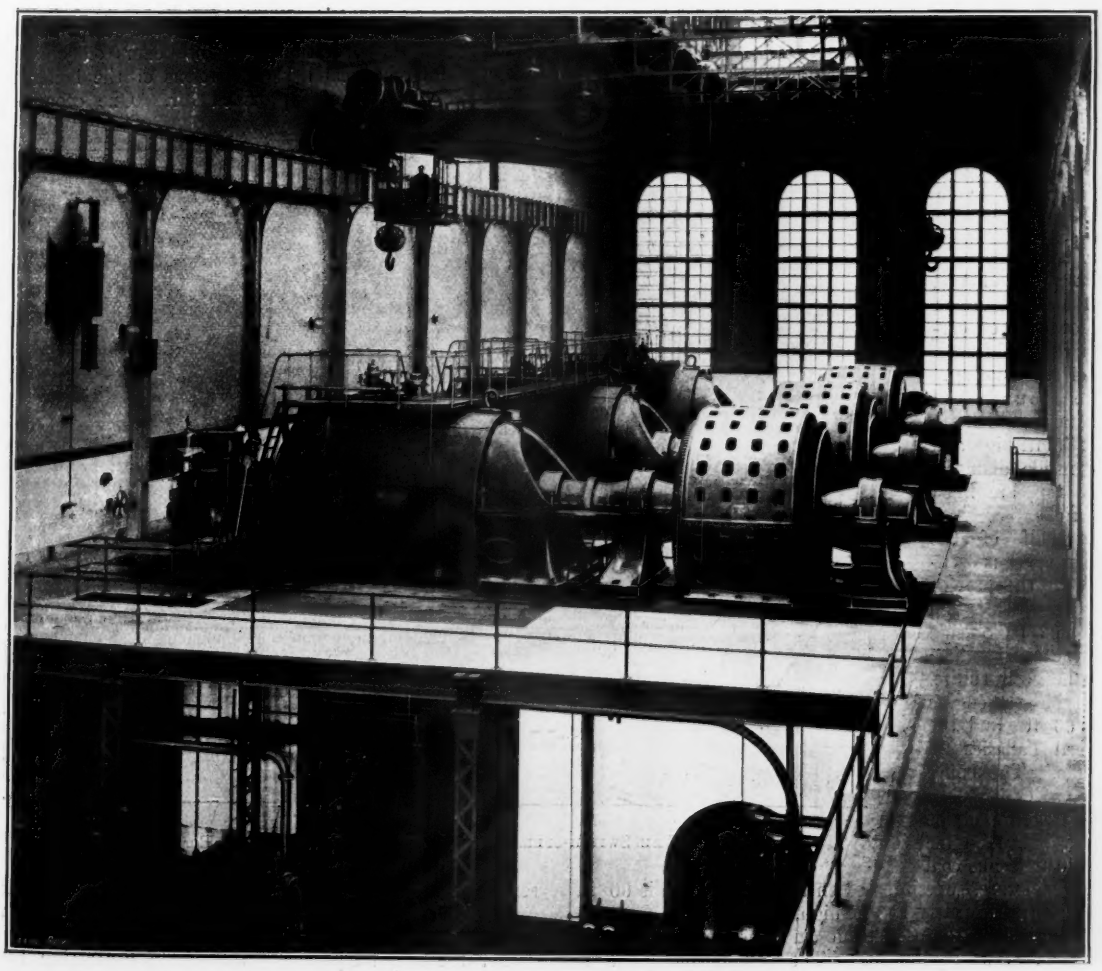


FIG. 2.—VIEW IN THE ENGINE ROOM: WESTINGHOUSE-PARSONS 5,500-KW. TURBO-GENERATORS.

for the connection of the united lines with the tracks of New York, New Haven and Hartford Railroad by means of a bridge over the East River to the northward of Long Island City.

The scheme for electrifying these lines originated with the determination of the Pennsylvania Railroad to establish a terminal in the heart of New York City (Manhattan Island). The plans provided for two main generating stations, one in New Jersey and the other at Long Island City, on the East River; this latter power station is described below.

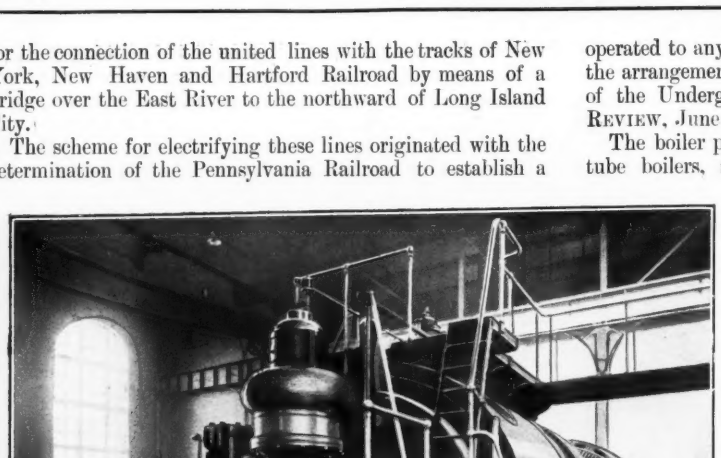


Fig. 3.—View of the Governor End of a 5,500-kw. Turbine Unit.

The station is available for water-borne coal and for an unlimited supply of salt water for the turbine condensers, and when ultimately operated in conjunction with the New Jersey power house, will be approximately in the centre of traffic density.

The roof and floors of the power house, figs. 1 and 12, are of reinforced concrete carried on the steel framework of the building.

The four steel smokestacks, which are each 275 ft. high and 16 ft. inside diameter at the top, are lined with bricks.

One half of the building space is occupied with the present structure, which is 200 ft. by 262 ft. outside measurement. The boiler house is 103 ft. wide inside, the engine room 66 ft., and the electrical galleries 25 ft. wide. The boiler house proper is 82 ft. high to the top of the parapet, and the engine room 70 ft. The coal bunker enclosure, superimposed on the boiler house is 60 ft. wide and its parapet is 118 ft. high.

The decision to use steam turbines governed many details of the equipment. The generating plant is divided into units and groups of units, which can be operated to any degree of combination, and largely follows the arrangement adopted at the Lot's Road power station of the Underground Electric Railways Co. (Electrical Review, June 9th and 16th, 1905).

The boiler plant consists of 32 Babcock & Wilcox water-tube boilers, set in batteries of two boilers each, eight batteries on the ground floor, and eight on the floor above. The boilers are designed for a working pressure of 200 lb. per sq. in.; each has a total heating surface of 5,243 sq. ft., and is supplied with a superheater, working at 200° F.

The coal bunker has a capacity of 5,200 American tons. A coal tower rises to a height 170 ft. above the adjacent dock, and the coal-hoisting machinery can handle 800 tons a day. The coal bucket is of the clam shell type, and holds 2 tons. The hoisting machinery is operated by steam, and the filling, raising and emptying of the shell is under the control of one man: the round trip occupying 45 seconds. The coal is weighed automatically, and the average cost of raising it from the barge and depositing it in the bunker is 5·113d. per ton. The coal is fed from the bunkers through spouts to the hoppers of Roney stokers. In each furnace the clinkers are disintegrated by means of steam jets and the ashes fall away by gravity, and are conveyed by motor-driven buckets to an ash bin of 300 tons capacity. The mechanical ash bucket holds 1,500 lb., and is raised and emptied under the supervision of one attendant in 3½ minutes.

The arrangement of flues, economisers, and dampers is such as to permit the operation of eight boilers on one turbine, but interchangeability of portions of the boiler and economiser plant is also provided for. One economiser serves two batteries of boilers. The system of feed water and steam piping is also looped and cross connected, and all systems of piping are painted on a definite colour scheme.

Fig. 4.—The Switch-operating Gallery, Showing Control Board, &c.

For the initial equipment, three main generating units have been installed, consisting of steam turbines directly

connected to three-phase 11,000-volt generators of the revolving field type. The turbines are of the Westinghouse-Parsons single-flow type rated to develop 5,500 KW. with 175 lb. steam pressure and 27½ in. vacuum, when running at 750 r.p.m. A general view of the three turbine units is given in fig. 2. The present building will accommodate three more turbines, and when the entire site is built over there will be 96 boilers and electrical machinery aggregating 105,000 E.H.P.

The turbines are practically identical in construction with those installed at Lot's Road power station, but were built by the Westinghouse Machine Co., East Pittsburg, Pa.

The speed of the turbine is varied by a little motor, which is controlled by suitable switch gear placed in the operating gallery, as is usual with this class of plant. Each turbine is also fitted with the usual automatic safety stop arrangement which shuts off the steam supply in case the speed exceeds a predetermined limit.

For distributing oil to the turbine bearings a storage tank 8 ft. dia. × 14 ft. 8 in. deep is provided, from which oil is fed by gravity to the bearings, passing thence to a filter tank from which it is automatically pumped back to the storage tank again. There are about 5,000 gals. of oil in this system, and about 90 gals. per min. is circulated through each turbine in operation.

A separate condenser of 20,000 sq. ft. cooling surface is installed directly under each turbine: the circulating water is obtained from and returned to the East River, by means of concrete tunnels, each 10 ft. diameter, under the boiler house. The intake is guarded with screens and an ice fender; and in the event of freezing a hot water supply is available.

A somewhat unusual feature has been introduced to prevent the serious deterioration usually occurring where salt water is used for circulation in surface condensers: galvanic action takes place in any event at the expense of condenser tubes, but this is often aggravated by the fact that the water and the body of the condenser form a convenient path for stray electric railway return currents.

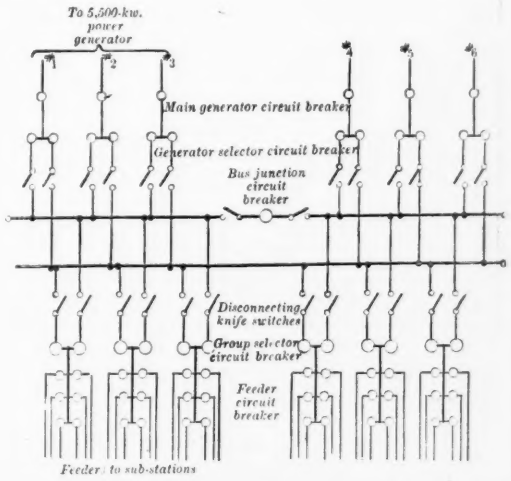


FIG. 5.—KEY PLAN OF GENERATOR AND FEEDER CONNECTIONS.

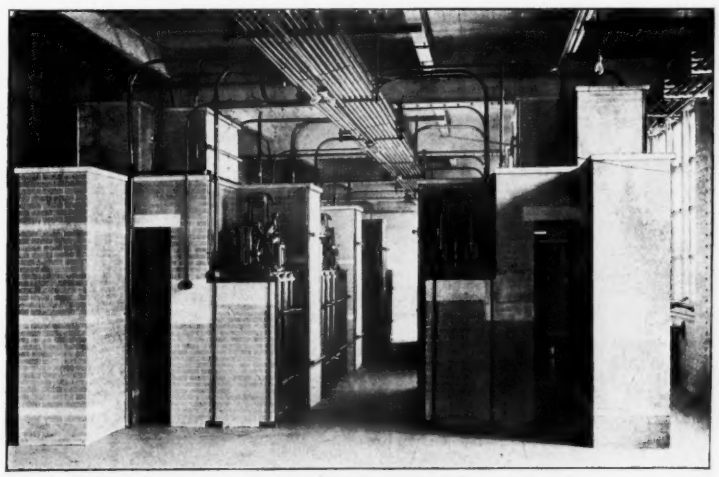


FIG. 6.—VIEW OF BUS STRUCTURE, SHOWING SELECTOR SWITCHES.

FIG. 7.—FEEDER GALLERY, SHOWING THE FEEDER AND GENERATOR CIRCUIT BREAKERS.

The metallic connections of the power station equipment to the city piping are through two 14-in. water mains, which are crossed by numerous trolley lines.

To prevent corrosion a shunt circuit is provided between the incoming water-pipes and the circulating water tunnel, in order to divert as large a proportion as possible of the current from the condensers. This is done by the insertion in each water main connection of a short piece of pipe with an insulating joint on each end of it. These short pieces of pipe are then connected by cable to the outer end of the condenser intake. Such current as may leak from the pipes to the water contained in them, thus has an opportunity to get back into the harbour without going through the piping system and the condensers.

In order to neutralise the effect of such current as might still leak past the insulating joints, a small booster generator is provided, driven by a 220-volt motor, the positive pole of the booster being connected to the heavy grounded shunt cable, and the negative pole to seven different points of each condenser, there being an adjustable rheostat in each of these branches of the negative circuit.

FIG. 8.—STORAGE BATTERY FOR THE EXCITER SYSTEM.

It is said that this superimposed voltage can be adjusted exactly to counterbalance the natural galvanic E.M.F.'s due to the brass tubes, the iron shell and the circulating water, together with the stray E.M.F.'s from outside.

A little switchboard panel is provided for each condenser, with seven rheostats mounted on it, and a differential voltmeter, which can be plugged to each of these sections of the negative circuit. The booster apparatus, shown in fig. 11, is conveniently situated in the electrical bus gallery, directly under the operating gallery. The rheostat panel for each condenser is placed in the engine-room basement. Patents are pending for this system of protecting condensing plants against electrolytic corrosion.

The 5,500-KW. generators are "star-wound," the neutral points of the three machines being connected to one neutral bus, which is permanently grounded through a resistance.

The fields are separately excited at 220 volts: the main generators are each guaranteed to deliver 289 amperes per terminal at 11,000 volts pressure and 80 to 100 per cent. power factor for 24 hours continuously, with a rise in temperature not exceeding 35° C.; and a 50 per cent. greater current for two hours, with a rise not exceeding 65° C. The generators and exciters, and all the high and low tension switch gear and control apparatus, were furnished by the Westinghouse Electric and Manufacturing Co.

Three separate sources are provided for exciting the fields of the main generators — viz., two steam-driven exciters, one motor-driven exciter and a storage battery. The steam-driven engine units each consist of a Westinghouse-Parsons steam turbine directly coupled to a 200-KW. D.C. turbo-generator, designed to run at 1,800 r.p.m. These turbines are designed to run either condensing or non-condensing with 175 lb. steam pressure and 200° F. superheat. The motor-driven exciter, also of 200 KW. capacity, is driven by a direct-coupled 290-H.P. three-phase 440-volt induction motor, placed in the operating gallery. The three-phase motor derives its current from three 175-KW. oil-insulated self-cooling transformers, placed in the basement of the electrical gallery.

The main generators are designed to run in parallel on either of two sets of the main bus-bars, only one of which is generally in use. Each generator is connected through a selector circuit-breaker and dis-

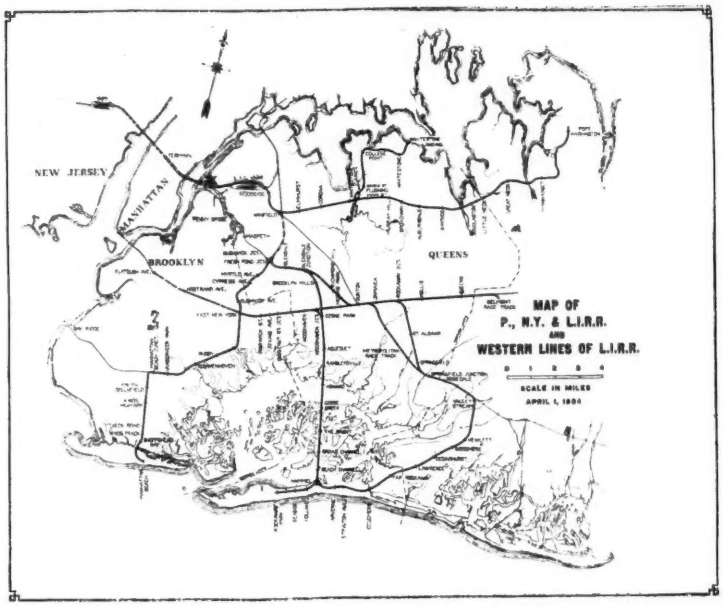
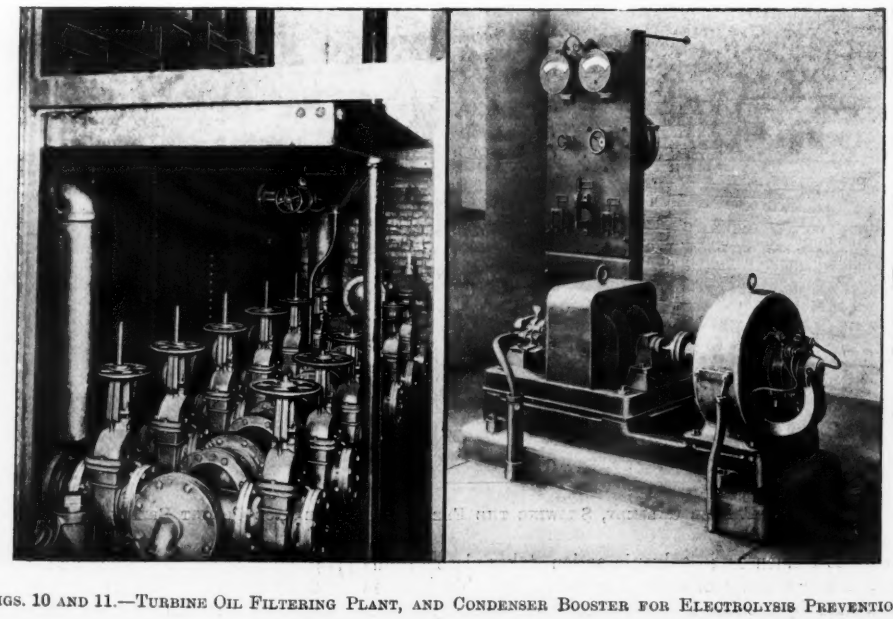


FIG. 9. PLAN OF THE LONG ISLAND ELECTRIC RAILWAYS.



FIGS. 10 AND 11.—TURBINE OIL FILTERING PLANT, AND CONDENSER BOOSTER FOR ELECTROLYSIS PREVENTION.

connecting knife switches to each bus-bar set. Each of the latter is again connected through disconnecting knife switches and group selector circuit-breakers to an auxiliary feeder bus, from which the outgoing feeders in groups of six are tapped through feeder circuit-breakers, as shown diagrammatically in fig. 5.

Any generator or any feeder group can thus be connected to either set of main bus-bars.

The generator leads pass through the basement to the main generator circuit-breakers which are located on the feeder gallery, these circuit-breakers are shown in fig. 7. The two sets of main bus-bars are arranged down either side of the gallery above, in masonry structures, and between them are placed the generator and feeder group selector circuit-breakers. Successive pairs of the latter switches are joined under the floor by the group feeder bus-bars, the feeder circuit-breakers being located on the floor below.

Fig. 6 shows the bus structures and selector switches, &c.; all the circuit-breakers are the well-known Westinghouse Type C oil switches, arranged for remote electrical control from the upper or operating gallery shown in fig. 4.

With the exception of the generator switches, which are four-pole in order to accommodate the neutral connection, all the oil switches are three-pole. The operating solenoids of the oil switches are energised by 220-volt D.C. from the auxiliary D.C. station bus-bar; the solenoid circuits being opened or closed by A.C. relays, energised from transformers, situated in the circuits under control. Individual manual control is effected from the control gallery, by closing the solenoid circuit by a switch which is in parallel with the automatic A.C. relay.

The operating switchgear includes a generator control bench, generator instruments in front of the bench, a feeder control board, an exciter and auxiliary D.C. switchboard.

The auxiliary board controls the supply to all the D.C. motors and lighting systems throughout the station, and from it is also supplied the energy for operating the various oil switches.

The arrangement and type of switchgear follows that adopted at the Neasden power station of the Metropolitan Railway (ELECTRICAL REVIEW, January 27th, 1905).

The H.T. cables in the power station are provided with a varnished cambric insulation, $\frac{1}{3}\frac{2}{2}$ in. thick, and are protected externally by double braiding; no lead sheathed cables are employed for any service. The General Electric Co. supplied the above H.T. cables, which were tested during 4 minutes with 30,000 volts.

A very complete system of signals for intercommunication between the engine man and the switchboard has been installed, which consists of a number of illuminated signals grouped together and located at a point visible from all parts of the engine room, and a large synchroscope. Fig. 2 shows the signal board mounted conspicuously on the south wall of the engine room, with the synchroscope on the top of it. The large letters and figures are illuminated from behind when the proper contact keys are pressed by the switchboard attendant. A corresponding set of keys at each turbine enables the engine man to light the answering signals on the instrument panel in the operating gallery.

The station was planned and built by Messrs. Westinghouse, Church, Kerr & Co., engineers, for the Pennsylvania, New York and Long Island Railroad Co., under the charge of Mr. George Gibbs, chief engineer of electric traction, and under the general supervision of the mechanical and electrical advisory committee of the New York extension, which is a committee composed of the officers of the Pennsylvania Railroad Co. We are indebted to the Westinghouse Co. for figs. 5, 9 and 12.

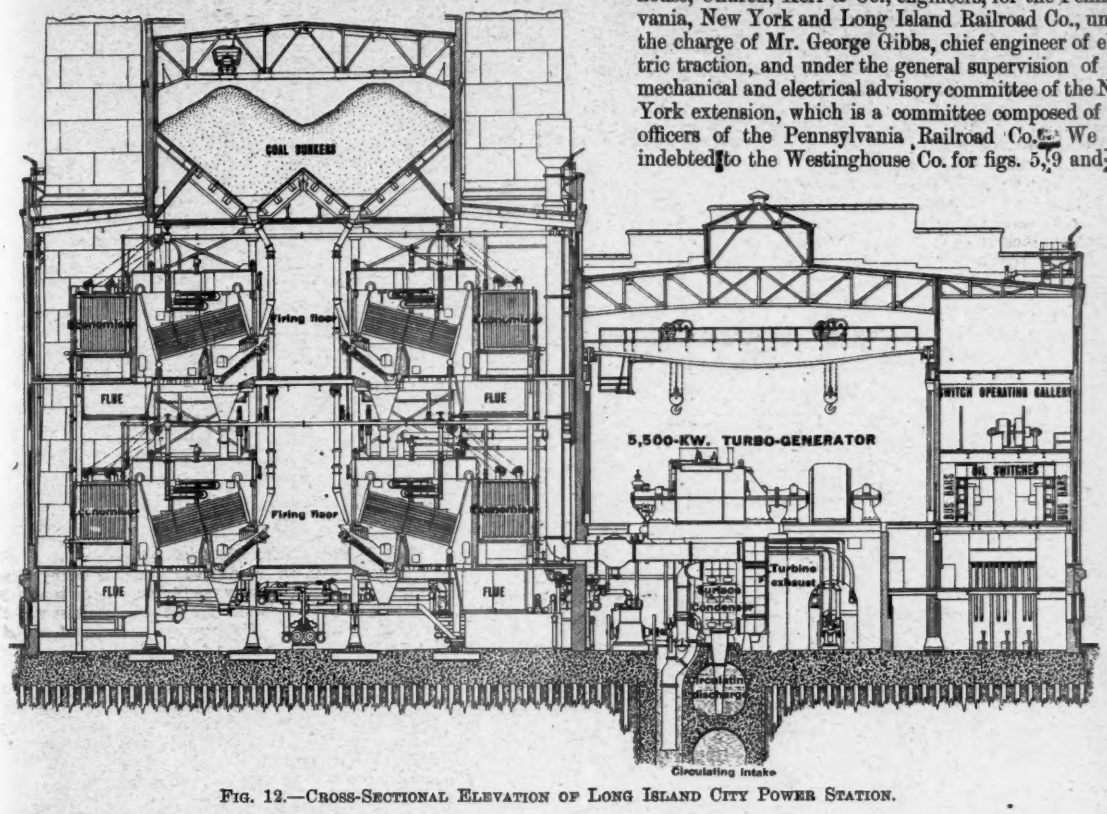


FIG. 12.—CROSS-SECTIONAL ELEVATION OF LONG ISLAND CITY POWER STATION.

NOTES.

(*Continued from page* 718.)

Institution and Lecture Notes.—INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—This Association, which holds its congresses about every three years in industrial centres in various countries, will this year meet in the Academy of Science at Brussels, from September 3rd to 8th. The programme of excursions includes visits to the Harbour Works at Brussels and at Antwerp, the Steel Works of the John Cockerill Co. at Seraing, the Arsenal at Mechlin, and the Harbour Works at Zeebrugge. Among the papers to be read will be one on "The Industries of Belgium," by Baron E. de Laveleye and M. Camerman. It is expected that a considerable number of members and delegates from this country will be present at the congress. Mr. J. E. Stead, F.R.S., Middlesbrough, is the English secretary of this Institution.

I.E.E. (LONDON STUDENTS).—About 23 members of the London Students' Section of the I.E.E. paid a visit to Manchester last week. The party left London on Monday morning, and on the way down broke their journey at Rugby, where they visited the works of the B.T.H. Co. After a tour of inspection of the various departments they resumed their journey to Manchester, arriving in the evening. Each morning and afternoon, visits were arranged to various works in the Manchester district, including the Chloride Electrical Storage Co., British Westinghouse Co., General Electric Co., Dick, Kerr & Co., and the Stuart Street generating station of the Manchester Corporation. On Wednesday evening a joint meeting was held with the Manchester Students' Section in the Municipal School of Technology (which the members also visited), when a discussion took place on "The Training of the Electrical Engineer." The discussion, which was opened by Mr. A. E. Jepson (Manchester), who was followed by a number of members of both sections, centred on the much vexed question of which training should come first, college or works, the majority being in

favour of the former. On Friday evening a dinner was held in the Grosvenor Hotel, at which a number of the Manchester Students were present.

The visit was much enjoyed by the members who took part, and could not fail to be instructive also.

INSTITUTION OF ELECTRICAL ENGINEERS (BIRMINGHAM LOCAL SECTION).—The report of the Committee to the annual general meeting to be held on Wednesday, May 9th, states that there was an average attendance of 61 at the meetings. The membership has increased from 293 to 302. The officers for 1906-7 are:—

Chairman.—R. A. Chattock.

Past Chairmen.—J. C. Vaudrey, M.Inst.C.E. (1903-4); W. E. Sumpner, D.Sc. (1904-5); R. Threlfall, F.R.S. (1905-6).

Vice-Chairman.—G. Kapp, M.Inst.C.E.

Ordinary Members of Committee.—A. H. Bate, W. E. Groves, C. W. Hill, F. Hird, S. H. Holden, R. C. Jackson, Henry Lea, M.Inst.C.E., R. K. Morcom, D. K. Morris, Ph.D., R. Orsettich.

Hon. Secretary.—H. B. Matthews.

The Committee announces the resignation at the end of the current session of Dr. D. K. Morris from the position of hon. local secretary, in which capacity he has acted since the Section was founded in 1899. Mr. H. B. Matthews, the present assistant secretary, has undertaken to accept the post of hon. secretary.

I.E.E. (CAPE TOWN).—The annual general meeting was held at the South African College on April 9th, Mr. John Denham presiding. The annual report says that the attendance never exceeded 20 per cent. of the full membership. The committee regretted that owing to the leisure time of the members of the British Association during their recent visit to Cape Town being taken up with various receptions by the Corporation, the Institution was unable to extend to them that hospitality that it desired. Mr. A. S. Giles was elected chairman for the ensuing year, Mr. Denham vice-chairman, and the committee were as follows: Messrs. Long, Banham, Pickering and Jones, with Mr. Horne as hon. secretary. A vote of thanks was unanimously conveyed to Mr. Denham for his able assistance in the management of the Institution during the year.

I.E.E. (GLASGOW SECTION).—The sixth annual report of this section shows an increase of 19 in the membership, the total being now 230 as compared with 211. Out of this increase 16 are students. The Committee for the 1906-7 Session is as follows:—

Chairman.—Lord Kelvin.
Past Chairmen.—Robert Robinson; John M. M. Munro.
Vice-Chairman.—W. W. Lackie.
Chairman of Student Section.—Prof. Magnus MacLean.
Hon. Sec. and Treasurer.—E. George Tidd.
Members.—Charles Day, The Mirrlees Watson Co., Ltd.; James Lowson, W. C. Martin & Co.; John Macfee, Chief Engineer, Glasgow Corporation Telephone Department; Sam. Mavor, Mavor & Coulson, Ltd.; T. Blackwood Murray, B.Sc., Albion Motor Car Co.; Frank A. Newington, Chief Engineer, Edinburgh Corporation Electricity Department; John S. Nicholson, Glasgow University; W. Stevenson, Caledonian Railway; A. W. Stewart, Consulting Engineer.

I.E.E. (MANCHESTER) STUDENTS.—The report of the Committee shows that during the past session there have been nine meetings and eight visits to works. The membership of the Section is now 324, an increase of 18. Schwartz premiums were awarded to Messrs. A. E. Jepson and F. O. Mills for their respective papers on "Electric Heating" and "Electric Railways," and the former also received a premium of £4 from the council of the Institution. The vice-chairman for 1906-7 is Mr. H. D. Symons, and the hon. sec. Mr. R. W. Willis.

INSTITUTION OF CIVIL ENGINEERS.—On Wednesday evening last, at the Institution of Civil Engineers, Mr. Hadfield delivered the "James Forrest Lecture," certain sections of which directly touched upon matters of electrical interest. In dealing with the physical properties of alloys, reference was made to the fact that whereas pure iron had a resistivity of 10 microhms per cubic centimetre, the value was increased in an iron nickel manganese alloy to 95 microhms. In regard to permeability, pure iron had a maximum value of 4,000 C.G.S. units, whereas the alloy referred to was practically non-magnetic with a value of 1·3 C.G.S. units. Reference was also made to the effect of temperature changes on nickel-iron and iron-manganese alloys. Experimental demonstrations given subsequently in the Reading Room showed that while these were non-magnetic at ordinary temperatures, upon cooling in liquid air they became magnetic, and maintained this property until heated to 500° C. These properties were accompanied by remarkable tenacity and ductility. With reference to the Heusler class of alloys of manganese, copper and aluminium, emphasis was again laid on the theory, advanced for the first time at a Royal Society meeting by Mr. Hadfield and Prof. Fleming, "that ferro-magnetism, *per se*, is not a property of the chemical atom, but of a certain kind of molecular grouping . . . . hence it may be possible to construct alloys which are as magnetic as, or even more magnetic than, iron itself." Concerning the electric furnace, the lecturer expressed his opinion that where water-power and suitable iron ore could be found together, satisfactory electrical smelting practice could be developed, but this could only come slowly. There was no magic in the electrical method, although the word "electric" dazzled the uninitiated. The electric furnace would not purify steel more than other furnaces not specially adapted to that purpose. Bad steel could be produced as easily in electric furnaces as in other processes. Another important question was, whether electric furnaces ensured uniformity of temperature. They were apt to produce steel much colder at the top than underneath, which was objectionable. At the conclusion of the lecture there was an adjournment to the Reading Room, which had been fitted up as a steel works laboratory. An excellent equipment permitted of the making of a number of striking tests illustrative of the chief points in the lecture itself.

ROYAL INSTITUTION.—The annual meeting of members was held on Tuesday. The following gentlemen were unanimously elected as officers for the ensuing year:—President, The Duke of Northumberland; treasurer, Sir James Crichton-Browne; secretary, Sir William Crookes; managers, Sir William de W. Abney, Lord Alverstone, Earl Cathcart, Dr. A. H. Church, Dr. F. Elgar, Dr. D. W. C. Hood, Mr. M. Horner, Sir William Huggins, Lord Kelvin, Mr. H. F. Makins, Dr. Ludwig Mond, Sir R. Douglas Powell, Bart., Lord Sanderson, Mr. Alexander Siemens, and Sir James Stirling; visitors, Dr. J. Mitchell Bruce, Mr. Dugald Clerk, Sir John George Craggs, Mr. H. Cunynghame, Mr. G. F. Deacon, Mr. E. Dent, Rev. J. H. Ellis, Mr. R. K. Gray, Mr. C. E. Groves, Mr. F. G. Henriques, Mr. A. C. Ionides, Mr. C. E Melchers, Mr. E. R. Merton, Mr. H. Swithinbank and Mr. G. P. Willoughby.

ROYAL SOCIETY.—At yesterday's meeting the following papers were read:—Mr. R. Threlfall, "On a Static Method of Comparing the Densities of Gases"; Sir William H. White, K.C.B., on "The Stability of Submarines"; Messrs. A. G. R. Foulerton and A. M. Kellas, on "The Action on Bacteria of Electrical Discharges of High Potential and Rapid Frequency," communicated by Prof. J. Rose Bradford, F.R.S.

BIRMINGHAM AND MIDLAND INSTITUTE.—The members of the Scientific Society of this Institute, under the direction of President G. Johnson, B.A., vice-president W. Rosenhain, B.A., B.C.E., the hon. secretary, Mr. A. Cresswell, and the hon. librarian, Mr. W. H. Derrington, visited the works of the British Thomson-Houston Co., Ltd., at Rugby, on Tuesday, and were very much interested in the labour-saving appliances and modern machines, as well as the manufacture of the Curtis steam turbine, which they saw there.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—The Association held a social (Bohemian Concert) on Saturday evening at St. Bride's Institute, E.C. The chair was occupied by their President, Mr. J. Patten Barber, M.Inst.C.E., and the event was the last assembly of the season.

SHEFFIELD SOCIETY OF ENGINEERS AND METALLURGISTS.—On April 23rd, Mr. Kenneth B. Stuart read a paper on "Electrical Power in Iron and Steel Works, with Special Reference to its Application to Rolling Mills."

LONDON CHAMBER OF COMMERCE.—Mr. Walter Hazell addressed a general meeting of members on Friday last on "The Advantages and Disadvantages of the Removal of Works from London to the Country."

Municipal Specifications.—We have frequently condemned the practice of engineers in stipulating in their specifications for particular makes of machinery instead of adopting the fairer plan of leaving the matter open for tenderers to show that they can secure with their own plant the results that the said engineers require. In the last issue of the *Local Government Journal* there is quoted a communication received from the Local Government Board by the Hayes Urban District Council in February last, which bears on this subject. The letter related to the application of the Council for sanction to borrow further money for works of sewerage and sewage disposal. The letter was ordered by the House of Commons to be printed April 4th, 1905, and it reads:—

"The inspectors report that the specification was drawn by the engineers without due regard for economy, that many of the materials specified were of a needlessly expensive character, and that the cost was probably increased by specifying particular firms from whom certain of the materials should be purchased (always a costly and generally an objectionable process), although, as regards some at least of these, there were other firms from whom materials of the nature and kind required could have been obtained."

Of how many electrical specifications could these remarks have been made?

Appointments Vacant.—Commercial assistant for the Birmingham Corporation Electricity Supply Department (£300); Battersea Polytechnic requires a head of the Department of Electrical Engineering from September next.

Fatalities.—A motor-driver on the Great Northern and City Railway remarked to his companion in the motor-cab that he heard something go "Click, click." He opened the side gate and looked out. Later on he was missing, and was found dead on the rails. Evidence was given to show that drivers had been cautioned against opening the gates when in tunnels, but the jury held that deceased was justified in opening the door of the car in the absence of printed prohibition.

The report of Mr. A. P. Trotter, Electrical Adviser to the Railway Department of the Board of Trade, upon the fatal accident which occurred, on March 21st, to E. R. Bone, at Notting Hill Gate sub-station on the Central London Railway, says:—"The accident cannot be attributed to any defect in the switch-gear or its position, nor to any rash attempt to tighten the bolts, nor to disobedience to the rules, nor to misjudgment by Bone of the distance between his finger and the switch, but merely to absent-mindedness. Bone had been engaged on such work for 10 months, and in this sub-station for six months. He was fully aware of the danger. This accident was due to absent-mindedness or momentary aberration of a competent man."

Milan Exhibition Opened.—The King and Queen of Italy attended the opening of the Milan Exhibition on 29th ult., but the *Times* says that the Exhibition "has still to be viewed with an eye of faith," though another week might see it almost completed.

The Westinghouse-Finzi Combination.—An agreement has recently been signed between the representative of the Westinghouse Co. and the Electric Railway Co., operating the patents of Dr. Finzi, whereby the two firms will work together in the supply of material and handling of contracts in Italy.

The Cardiff Arbitration Case.—The *Western Mail* says that Mr. Patchell, arbitrator, on Monday resumed his investigation into the dispute which has arisen between the Cardiff Corporation and Messrs. Firth & Sons, of Manchester, with regard to the contract for the electric lighting of the Whitchurch Asylum. The arbitrator reserved his award.

A Hove Race.—The employés of the Hove electricity works recently had their fourth annual race—a "go-as-you-please" from Partridge Green *vid* Steyning and Bramber, to the electricity works in Hove, a distance of 16 miles. H. Harper, the first man home, took 1 hr. 54 min. 45 sec.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers.—On April 27th Mr. J. THOMSON, chief assistant in the Leith Corporation electricity works, was presented with a marble timepiece, the gift of the staff, employés and friends, on the occasion of his marriage, which took place on the following day. Mr. A. Peden Rutherford, the burgh electrical engineer, made the presentation, and Mr. Thomson suitably replied.

Mr. J. F. SHOOLBRED, electrical engineer at Newcastle-under-Lyme, has been appointed manager of the English Electricity Works at Tucuman, Argentine Republic, and sails on May 11th.

The Wrexham T.C. has granted Mr. SILLERY, electrical engineer, an honorarium of £30 for special services in connection with the E.L. extensions.

Mr. C. ASHMORE BAKER, of Dudley, has joined Mr. Reginald P. Wilson at Westminster. Mr. C. E. SAVAGE takes his place as resident engineer at Dudley, with Mr. E. S. HOUNAM as chief assistant.

Mr. P. G. MOORE, on leaving Birkenhead to take up the appointment of assistant engineer at the Cawnpore works of the Indian Electric Supply and Traction Co., was on Saturday last presented by the staff with a pair of binoculars. Mr. Wm. Bates, the borough electrical engineer, made the presentation.

Mr. L. R. LEE, who was recently appointed electrical and mechanical engineer in the Fire Brigade Department of the London County Council, has asked to be allowed to withdraw his application for the position. Having interviewed the three candidates considered to be next in order of merit, the Fire Brigade Committee recommended that Mr. EUSTACE RIDLEY should fill the appointment. Mr. Ridley has therefore resigned the position he has held for eight years as chief engineer of the Smithfield Markets Electric Supply Co., Ltd., to take up the appointment.

The Gloucester T.C. has voted Mr. W. J. BACHE, the late electrical engineer, an honorarium of £44 12s. 6d. in respect of extra services rendered in connection with the electrification of the tramways. Mr. Bache had made a claim for £260 odd.

On April 24th Mr. C. L. E. STEWART, A.M.I.E.E., the chief assistant electrical engineer at Rochdale, was married to Alice Smithies, youngest daughter of L. Smithies, Esq., of Rochdale. Mr. Stewart was presented by the staff and workmen with a set of carvers.

General.—Mr. J. R. W. ST. JOHN BROWN, or Leytonstone, has been appointed canvasser to the Hammersmith electrical undertaking. There were 300 candidates.

Mr. J. JEFFRIES, A.M.I.E.E., has been appointed resident engineer by the Brush Co. for the Jarrow-on-Tyne Light Railways contract.

Mr. W. H. COWING, for some years on the staff of the General Electric Co., Ltd., and for the past two years works manager of the Morris-Hawkins Electrical Co., has resigned his position in order to join Messrs. Kramos, Ltd., Bath, taking up the position of works manager.

On April 26th, at Wesley's Chapel, City Road, London, the marriage was solemnised of Mr. WILLIAM CROSS, A.M.I.E.E. (partner in the firm of Falconar, Cross & Co.), of Newcastle-on-Tyne, to Edith Annie, daughter of R. Pickering, Esq., of Blaydon. Mr. Cross has been honorary secretary of the Northern Section of the Electrical Contractors' Association (Inc.) since its inauguration, and the Northern and London Sections recently made him a present of a silver tray, a cigarette box and a trinket box.

NEW COMPANIES REGISTERED.

Manchester Electrobus Co., Ltd. (88,556).—This company was registered on April 26th, with a capital of £100 in £1 shares, to adopt an agreement with the X Electric Accumulator Co., Ltd., and to carry on the business of motor-omnibus and vehicle proprietors, jobmasters, contractors, carriers of passengers and goods, &c. The first subscribers (each with one share) are:—G. W. Statham, 21, Ironmonger Lane, E.C., solicitor; G. H. Lloyd, 20, Half Moon Street, E.C., mechanical engineer; E. L. Oppermann, 21, Ashmead Mansions, W., electrical engineer; H. C. Lloyd, 106, New Bond Street, W., gentleman; J. T. Jones, Warnford Court, E.C., stockbroker; J. McCanna, 9, Upper Chadwell Street, E.C., managing clerk; and C. N. Jolly, 44, Stockwell Park Crescent, S.W., clerk. No initial public issue. Registered without articles of association.

Liverpool Electrobus Co., Ltd. (88,548).—This company was registered on April 26th, with a capital of £100 in £1 shares. Objects and all other particulars as Manchester Electrobus Co., Ltd. (*q.v.*)

Lancashire and Yorkshire Electrobus Co., Ltd. (88,547).—This company was registered on April 26th, with a capital of £100 in £1 shares. Objects and a l other particulars as Manchester Electrobus Co., Ltd. (*q.v.*)

Birmingham Electrobus Co., Ltd. (88,539).—This company was registered on April 26th, with a capital of £100 in £1 shares. Objects and all other particulars as Manchester Electrobus Co., Ltd. (*q.v.*)

Nottingham Electrobus Co., Ltd. (88,549).—This company was registered on April 26th, with a capital of £100 in £1 shares. Objects and all other particulars as Manchester Electrobus Co., Ltd. (*q.v.*)

Provincial Electrobus Co., Ltd. (88,552).—This company was registered on April 26th, with a capital of £100 in £1 shares. Objects and all other particulars as Manchester Electrobus Co., Ltd. (*q.v.*)

London Electrobus Co., Ltd. (88,381).—This company, which was registered on April 11th, with a nominal capital of £100, increased such capital to £305,000 a few days later.

Telegraphone, Ltd. — This company was registered on April 25th, with a capital of £100,000 in £1 shares, to adopt an agreement with the Aktienselskabet Telegraphonen Patent Poulsen, of Copenhagen, to acquire, prolong and renew certain patents and patent rights specified in such agreement and to manufacture or cause to be manufactured, sell, let on hire and deal in telegraphones and other instruments, mechanical appliances, &c. The first subscribers (each with one share) are:—C. Hage, Copenhagen, merchant; Baron Adolf von Cramm, Bennett Street, St. James's, S.W.; H. Snowdon, Balfour House, Finsbury Pavement, E.C., electrical engineer; G. W. Ollett, 28-9, St. Swithins Lane, E.C., secretary; S. C. Lambert, 111, Highbury Hill, N., accountant; R. F. Collinge, 115, New Bond Street, W., electrical engineer; and C. Hodges, Balfour House, Finsbury Pavement, electrical engineer. Minimum cash subscription, £15,000. The number of directors is not to be less than three nor more than five; the first are to be appointed by the subscribers; qualification, £100 shares or stock; remuneration (except managing directors), £200 each per annum, with £100 extra for the chairman, and 10 per cent. of the surplus profits remaining after a dividend of 10 per cent. has been paid, divisible. Registered office, 28-9, St. Swithins Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Medical Electro-Vibration Institute, Ltd. (87,372).—This company's annual return was filed on April 20th, when 7 shares had been taken up out of a nominal capital of £1,000 in £1 shares, and £7 had been received. Mortgages and charges: Nil.

Willey & Co., Ltd. (79,618).—This company's annual return was filed on April 12th, when the entire capital of £100,000 in £1 shares (25,000 preference) had been taken up, £7 had been received, and £99,993 is considered as paid. Mortgages and charges: £20,000.

CITY NOTES.

Oriental Telephone and Electric Co.

THE twelfth ordinary general meeting was held on Monday at the Great Eastern Hotel, Liverpool Street, Sir Auckland Colvin, K.C.S.I., in the chair.

In proposing the adoption of the report (see ELECTRICAL REVIEW, April 27th), the CHAIRMAN said he thought the shareholders would agree that it justified the hopeful expectations expressed at last year's meeting, inasmuch as while strengthening their reserve they had found themselves able to increase the dividend on the ordinary shares for the past year to 7 per cent. The net profits showed a substantial increase over those of the year 1904. The steady progress of the business at the branches of the company as well as in the subsidiary companies was maintained. The work of reconstructing and cabling the company's system was well in hand, and they would notice from the accounts that a sum of £16,337 had been expended up to December 31st in connection with that work, but a considerable amount had since been added as the work progressed, and in the course of next year they hoped the expenditure would practically be completed. As he mentioned last year, the directors decided that the time had arrived to establish a sinking fund for the better security of the capital of the company, apart from the debenture issue, and a sum of £7,000 had, after consultation with the auditors, been set aside for investment this year. That sum was in addition to the annual amount of £887 which would be required from the 1st of January next for redemption of £100,000 debenture stock issued last year. The former amount, though apparently small, was sufficient for the purpose, and he felt sure that the action of the board would commend itself to the approval of the shareholders. In addition, the directors deemed it advisable in view of the constant calls for increased capital expenditure to continue to build up the reserve fund, and they recommended placing £6,000 to that account, being £3,000 more than on the last occasion. That sum might appear high, but the balance standing at the credit of that account would be fully utilised when the metallic circuiting at the branches of the company was completed, and in adjustment of the cost made in the accounts, the board being anxious to keep down the interest-bearing capital as far as possible. With reference to the loan of £21,500 appearing in the balance-sheet, he would like to explain that that sum was advanced to the Telephone Co. of Egypt in December last to meet a call upon the company for funds to enable them to purchase premises for their own use in Alexandria. That amount, he might say, had since been repaid with interest. The Telephone Company of Egypt which, as they were aware, was one of the most valuable assets of the company, continued to make steady progress. In Cairo and Alexandria as well as in the various provincial towns in which

exchanges had been established, considerable additions had been made to the numbers of exchange and private lines during the past year, while the trunk lines between Cairo and Alexandria continued to be increasingly used, and undoubtedly had proved a very great convenience to the communities of those two towns. The additional trunk lines to which he referred last year, were not as yet in operation, but while their company was not in any way responsible for the delay, they had good reason to believe that the lines would be completed and placed by the Government at their disposal in the course of the next few months. As regarded the provincial telephones required for the Government for administrative purposes those already in use continued to give satisfaction, and they looked forward to a progressive development in that connection in the future. The Bombay Telephone Co. also continued to develop in a satisfactory manner. The same dividend had been declared as in the previous year, viz., 6 per cent. The very difficult operations of metallic circuiting, transferring the company's business to new quarters, and installing new switchboards, were now in progress, and when completed all indications pointed to a future of increasing prosperity for that company. The Bengal Co. paid the same dividend as in 1904—5 per cent., and also had its work of reconstruction in hand, which it was believed would result when completed in securing an extension of its business. Following on the visit of inspection of one of their colleagues to the East in 1901, Mr. Chalmers, their secretary, had just returned from paying a tour of inspection of the branches of the company, and its subsidiary companies in China, Singapore, Rangoon and India. Mr. Chalmers had been carefully investigating all departments of the company's business in the East, and there was no doubt that the information and experience he had gained would be of great service to them, and would enable them better to deal with any questions or problems which might arise in the future affecting the welfare of the company and its allied undertakings.

Mr. Henry Grewing seconded the motion, and the report was adopted.

Elmore's German and Austro-Hungarian Metal Co.

The directors' report for 1905 says that the reduction and re-arrangement of capital have been duly carried out, and that the debit balance of £11,052 brought forward from 1904 has been duly written off, and also that the patent account has been reduced to the sum of £23,278. The items of profit and loss show but little alteration compared with those of the previous year, while the total charges for the year are a little less. The Metall Co. has declared the same dividend as last year, viz. :—11 per cent., which, with the amount received from that company by way of interest on loan, is sufficient to pay the whole of the standing charges of this company for the year, and carry a balance of £176 forward.

The accounts of the Metall Co. show that the profit on factory account, viz., M.520,826.33 (say £26,041) is larger than that made in any previous year, and after the general expenses were deducted, left M.126,600.33 (say £6,330) available for dividend and reserve. A dividend of 11 per cent. has been declared, leaving M.16,600.33, which has been added to the reserve account, which now stands at M.30,162.72. The net profit made cannot be considered as entirely satisfactory, but it must be remembered that during the year considerable extraordinary expenditure was incurred, the whole of which was paid out of the profits for the year. This expenditure could have been spread over a period of years, but the directors have deemed it advisable to charge the whole to the year 1905, and thus permit the year 1906 to start without encumbrance or burden of any kind. These extraordinary charges have ceased, and it is not anticipated that they will occur again. The directors regret that there has been an increase in nearly all the items of expenditure, but apart from the exceptional charges above referred to, such increase is not serious. Owing to the high price of copper more capital has had to be employed, the interest account is therefore higher, while wages and depreciation also show a considerable increase. During the year a considerable sum was spent in additions to plant, buildings, &c.; this expenditure was rendered necessary owing to the introduction of the auxiliary tube producing process and was essential to economical production. Considerable economies in production have been effected during the past year, the full benefit of which, however, is only now being felt. There is a continuance in the supply of orders, especially for the company's specialities, for which good prices are being obtained.

City of Birmingham Tramways Co.

The annual meeting of this company was held on 27th ult. at Birmingham.

Mr. E. Garcke, the chairman, said that the gross receipts amounted to £295,000, as against £294,000 in 1904, and the net receipts were £94,700, as against £84,400. They recommended a dividend on the ordinary shares at the rate of 10 per cent., leaving a net surplus of £64,300 to be added to the reserve fund. The capital expenditure showed an increase of £26,000, due to the additional cars which they had acquired and the electric lines and the additional plant at Yardley power house. He told them last year that they had nothing to fear in regard to the competition of motor-omnibuses with their electric and steam lines. A new company was formed to take over the motor-omnibus undertaking, the horse omnibus undertaking of that company, and the horse omnibus undertaking of the Birmingham and Midland Tramway Co. The various companies, instead of taking payment in cash, took an equivalent in shares. The Birmingham Tramway Co. received preference shares in respect of the actual assets which they transferred to the new company, and ordinary shares for the remainder. In that way they were paid £42,600; but they subsequently subscribed for additional shares, and also supplied the company with additional motor-omnibuses. They were in negotiation with the King's Norton District Council for that portion of the King's Norton and Moseley Steam Tramways within their district. The portion within the city would pass to the Corporation of Birmingham at the end of the year, and the King's Norton District Council had the right to purchase the remaining portion of the route, and they were in negotiation with the view to facilitating the reconstruction of the line and equipping it with electric traction when the Corporation line would be ready for that system of traction. They were doing everything in their power to facilitate the electrical conversion, not only of the portion acquired by the Birmingham Corporation, but of the portion within the area of the adjoining authorities. Municipalisation having been decided upon, there was no object in doing anything but to facilitate the conversion for the convenience of the public. They had had some difficulty in reference to Erdington. They entered into an agreement to work tramways to be constructed by the Erdington Council, and also to carry out their electric lighting order. They were to pay interest and sinking fund charges upon the capital expenditure incurred by the Council; but when the plans were prepared they found that the Council proposed to do the work in a more costly manner than they thought to be necessary. Negotiations took place, and resulted in arbitration proceedings, which had not disposed of the difficulty. They could not expect to maintain the very satisfactory balance-sheets in the future, as the steam lines would pass to the Corporation at the end of the present year, and they would lose the revenues of those lines. They would also suffer some diminution of revenue from the competition of lines which the Corporation had opened.

Callender's Cable and Construction Co.

The directors' report for 1905 shows a balance at the credit of profit and loss for the year's working of £79,095, plus balance brought forward from 1904, £23,407, making together £102,501. Interest on debenture stock absorbs £13,500; dividend on preference shares, £10,000; appropriation for depreciation of plant and machinery, £13,014; appropriation for depreciation of office furniture and wharf, £816; leaving an available balance of £65,172. It is proposed to pay a dividend on the ordinary shares at the rate of 10 per cent. per annum, free of income-tax, being 10s. per share, whereof 5s. was paid on November 1st, 1905, and 5s. will be paid on May 31st, 1906 = £17,500; to pay a bonus of 5s. per share = £8,750; and to carry forward £38,922.

The profits on the company's operations during 1905 are thus £22,029, in excess of those of the previous year. The directors consider this result to be satisfactory. It has been arrived at in spite of continued keen competition, and unusual difficulties due to the exceptional position of the metal market. The state of trade throughout the country was, however, on the whole, somewhat more satisfactory than during the previous year, and a large business was done, especially in the closing months, when the general conditions became better than for some time past. The continued progress which was then looked for has, however, not been fully maintained, largely due in this company's case to the high price of copper and to the uncertainty in regard to legislation in Parliament affecting electricity supply. In spite of this, however, considerable contracts have already been secured, and the directors anticipate that a fair amount of work will be obtained during the current year. The company once again devoted much attention to developing its foreign trade, with the result that its operations in India have been still further extended, and a large amount of important work has been carried out in that country. A new contract has been secured in Hong Kong, which is still in course of execution, and mains have been supplied for Dunedin, Fremantle and elsewhere in Australia. Contracts have been secured for mains in Shanghai and in Rangoon, but the actual work in these cities was not taken in hand until the beginning of the present year. A contract for Bahia Blanca, in the Argentine, has been secured.

Many important orders were received for work in this country from municipal undertakings, from private lighting and railway companies, and from power companies; and, generally speaking, the company's business has been consolidated and increased, and its position fully maintained during the past year. The wharf at Grosvenor Road, being now of little service to the company, has been disposed of. The complete co-organisation of the Anchor Works has been carried out, and the factory and business have been put into a satisfactory position, although, owing to the continued high price of rubber, and the consequent restricted state of that trade, this company has not yet reaped the benefit which it will eventually obtain from this investment. The control of the Anchor business, however, has already proved of the greatest service in many ways to the company's interests.

West London and Provincial Electric Supply Co.

Sir J. Brooke Hitching presided at an extraordinary general meeting held at Winchester House on Tuesday, when resolutions were unanimously passed capitalising the arrears of dividend accumulated on the 6 per cent. preference shares to December, 1905, by issuing funding certificates carrying 4½ per cent. per annum, to be cumulative as from July 1st next, such interest being payable exclusively out of the profits of the company, after providing the preference dividend for the year. Provisions for the redemption of these funding certificates were also embodied in the resolutions. Agreements between Mr. W. B. Esson, as representing preference shareholders and the company, and between Mr. Esson and other ordinary shareholders and the company, were confirmed.

In a circular issued to the shareholders it had been explained that the total arrear which occurred during the building up of the business was equal to about 24 per cent. of the face value of the shares, or £11,400. The company is now earning increasing profits,

and it is anticipated that in some years' time the arrears will be wiped off, but in the meanwhile their existence has a detrimental effect upon the shares. The directors consider that the temporary capitalising of the arrears will have a beneficial effect upon the company's credit, and will operate fairly to both classes of shareholders.

The CHAIRMAN said that it was extremely difficult to get profits out of electric lighting undertakings until they had been established for some years. The preference shares had been dividend yielding for some time, and they hoped now that the ordinary shares in the course of two years would yield a satisfactory dividend. When once ordinary shares in electrical undertakings began to yield satisfactory dividends, the value of the shares went up by leaps and bounds. That had been the experience of all well-managed companies.

British Aluminium Co.

Mr. J. D. BONNER, in moving the adoption of the report (see ELECTRICAL REVIEW, April 20th), at the annual meeting held on Monday at Winchester House, said that the report disclosed a larger profit than any of its predecessors. The profit for the year carried to appropriation account was £93,296, an increase of £37,885 over that of the previous year. That result had been attained notwithstanding that the £33,599 invested in Loch Leven Water and Electric Power Co. yielded no income. Although that company was empowered under its Act to pay 3 per cent. interest on its capital during construction of works, no interest had been paid. This company would have to pay a further £8 per share on its Loch Leven shares, as the money would be required to complete the development of that scheme. As the directors of the British Aluminium would also require additional capital for important extensions to the present works, and the erection of new works, they had decided to ask the meeting to create and authorise the issue of 20,000 conversion shares of £10 each. They were steadily redeeming their debenture stock in accordance with the obligation to which they were subject, to apply 25 per cent. of the divisible profits to that purpose. The amount of such stock outstanding had been reduced to £258,000. The amount due from sundry creditors had increased, mainly because of the larger sales, and this accounted also for the reduction of stocks of aluminium. Recently the demand for aluminium had exceeded production which was interfered with all over the world last year by the want of water and other troubles. Owing to the phenomenal drought in Scotland this company's own production was considerably reduced for four months, and during a third of that period the works were practically at a standstill. Fortunately, they had a stock which carried them on for a time, but in the autumn the demand increased, and it became clear that in the interval before the Loch Leven works could become productive, the maximum they could produce at Foyers would not suffice to supply their customers. On the Continent the situation was very similar, and although the aluminium producers had large new works in course of erection, it was clear that there could be no surplus production on the Continent until next year. In October last he went to America to confer with the aluminium producers there, and he found that they had no water power unutilised. He was able to make arrangements for considerable shipments to commence next month, this company supplying the alumina from their own works. The advance which had taken place in the price of aluminium should enable them to realise a very large profit on the transaction. They had lately been effecting sales at prices substantially higher than a year ago, though they had not been disposing of their production at anything like the prices reported in the newspapers recently. They should have considerable increase in their production by this time next year. A very large extension of the Larne works was well advanced, but the event to which they were looking forward was the completion of their great power scheme at Loch Leven, which was still a long way off. The building of the dam was a great task. It would be 80 ft. high, 1,000 yds. long, 80 ft. wide at its base, and 10 ft. wide at the top. It would hold up water which would form a lake of four square miles, and would contain more water than any other artificial lake in Europe. It would enable them to run their own works through even such a phenomenally dry season as they had at Foyers last year. They had to construct a conduit four miles long, to erect a power station, and generating plant—which Sir Alexander Kennedy was designing with the assistance of Mr. Morrison—also buildings to accommodate their workmen. They would have far more power at their disposal than they originally expected. If the circumstances should justify them in utilising the whole of that power, they would be able to make at Loch Leven three times as much as they could make at Foyers.

Mr. WOLFENDEN seconded the motion.

In the course of a brief discussion, Mr. H. F. MAKINS said that in view of the very glowing position of the company, the writing down of the shares from £10 to £1 a short time ago was most unnecessary, not to say unjust. They would now be receiving 7 per cent. on £1 instead of on £10.

Another SHAREHOLDER said that the time was coming when even Loch Leven would not be adequate to meet the demand for aluminium.

In reply to these and other speakers,

The CHAIRMAN said that the prophesy they made when they issued the Loch Leven debentures was that prior to the completion of the Loch Leven scheme and their getting the benefit of the output there, their earnings would be sufficient to enable a dividend of 7 per cent. to be paid upon the total ordinary capital. They did that last year, and he expressed the opinion that they would be able to do the same this year and next year. The total capital expenditure at Loch Leven would not be less than £600,000. They had originally hoped they would be able to build it for half a million, but it seemed pretty clear that they were to get 30 per cent. more power than originally expected, and they would get it for about 20 per cent. increase in cost. In reply to Mr. Makins, if that capital had not been written down he would not be getting a dividend even upon his £1. The capital that was written off was certified by Messrs. Harmood Banner as having been absolutely lost. There was no appreciation in the assets which they then held.

The report was unanimously adopted, and the resolution, paying dividends aggregating £27,254, was carried.

Lord Kelvin and Mr. R. Heath were re-elected directors.

Lord KELVIN, who was very heartily received, in acknowledging the vote said he had been a member of the company from the very beginning, and a director during a time of great difficulties, which were the subject of much anxiety. Several years passed before they saw their way through those difficulties; at last brighter times came, and it had been a very great pleasure indeed to all of them to experience the great improvements in the position of the aluminium industry in general, and of the British Aluminium Co. in particular. He looked forward hopefully to the future, believing that the prosperity which had been growing during the last few years would go on with an accelerating rate. He only wished they had the Loch Leven scheme going now, but work of that kind could not be done in a short time. With patience, he hoped, they would see it working with splendid effect in producing aluminium, and continuing the prosperity of the company.

The auditors having been re-elected, the meeting became extraordinary and passed resolutions increasing the capital from £500,000 to £700,000 by the conversion of 20,000 £10 conversion shares to be alloted to the existing holders of the 7 per cent. preference and ordinary shares to carry 5 per cent. interest until they were fully paid up, after which they will be sub-divided into one 7 per cent. preference share of £5 and one ordinary of £5.

Further resolutions were passed unanimously paying 5,000 guineas to the Chairman (Mr. Bonner) and the Vice-chairman (Mr. Wolfenden) as additional remuneration for services rendered up to December, 1904, such sum to include the 2,000 guineas voted to them on April 18th, 1905; also increasing the annual remuneration of the directors from £1,000 to £2,000 for 1905 and 1906.

The meeting closed with a vote of thanks to the chairman and board.

Kalgoorlie Electric Tramways, Ltd. (Western Australia).

THE directors' report for 1905 states that the gross receipts were £53,512, and the total expenditure in London and Kalgoorlie £37,570, leaving a profit of £15,942. After lengthy negotiations, an arrangement has now been arrived at with the Kalgoorlie Electric Lighting and Power Co. for a considerable reduction in the price of power. The rate has been reduced from 4d. to 3½d. per unit as from June 1st to December 31st, 1905; to 3d. per unit as from January 1st to March 31st, 1906, and to 2¾d. per unit as from April 1st, 1906, for a period of five years with an option to this company to continue at the same rate for a further period of five years. The contract entered into with the Power Co. in August last will remain in abeyance whilst the present arrangement is in force. In the accounts now presented power has been charged at 4d. for the first five months and 3½d. for the last seven months. Under the new arrangement, with the cost of power at 2¾d. per unit, the profit at the present rate of consumption of power will be increased by about £4,000 per annum.

During the past year an amount of £10,655 has been expended on capital account. After payment of interest on the "A" and "B" debenture stocks, a balance of £4,792 is carried forward. The first annual payment in respect of the sinking fund for the redemption of the debenture stock is due and will be made on June 30th next. The directors receive most satisfactory accounts as to the permanence and stability of Kalgoorlie and Boulder City. Many buildings of a permanent character are constantly being erected, and the completion of the track comprising the Boulder concession has resulted in miners, who formerly camped on the mining leases, making permanent homes on the tramway routes. Car bodies can now be built locally, thus saving expenditure on freight and Customs duties, and giving support to local industries. The directors record their appreciation of the services of Mr. E. Graham Price and Mr. W. H. Stanley and the staff in Western Australia for the work done by them during the year under review. The total mileage is 20½.

In the manager's report it is stated that during the year three trailers, five small cars and one sprinkler have been added—three under-carriages for the trailers being imported and the three bodies built locally. During the year a number of the small cars have been fitted with steel-tired wheels, and are all running very satisfactorily.

During the year the cars travelled 683,827 car-miles as against 609,389 car-miles in 1904, and carried 3,301,989 passengers as against 2,908,593 in 1904. The earnings per car-mile in 1905 were 18·74d. as against 19·24d. in 1904, with an expense of 12·30d. per car-mile in 1905 as against 12·65d. in 1904. The expenses per cent. of earnings in 1905 were 65·61 as against 65·77 in 1904.

The total receipts, including car advertising, in 1905 were £53,413, as against £48,868 in 1904, and the total Kalgoorlie expenses in 1905 were £35,045, as against £32,139 in 1904, leaving a net profit of £18,367 for the year 1905, as against £16,718 in 1904. The number of units consumed in 1905 was 909,597½ (£14,223), as against 832,553½ (£13,876) in 1904.

North of Scotland Electric Light and Power Co.

The directors' report for 1905 states that substantial progress has been made by the company. The lamp connections in Montrose have been increased from 15,160 to 17,542, and in Brechin from 12,081 to 15.019. The Inverness undertaking commenced supplying current in May last, and the number of lamps connected at the end of the year was 5,322, making a total for the three towns of 37,883 equivalent 8-c.p. lamps. The result of the year's trading, including a balance of £432 brought forward from the previous year, shows a gross profit of £2,902, and after allowing £1,239 for interest on debentures and outstanding loans and £93 on exhibition account there remains a balance of £1,569 available for distribution. The directors recommend a payment of 2½ per cent. per annum, which will absorb £1,250, that £200 be placed to renewal fund, and £50 to a reserve for bad and doubtful debts, leaving a balance of £69 to be carried forward to next account.

Statement of Electricity Generated, Sold, &c.

—	Montrose.		Brechin.		Inverness.	
Quantity generated in Board of Trade units		218,234		136,362		38,904
Quantity Sold.						
Public lamps ..) By contract ..)	43,873		26,082			
Private consumers by meter	116,082		78,042		22,730	
Total sold	159,955		104,124		22,730	
Quantity used on works	49,003		24,983		8,746	
Total quantity accounted for ..	208,958		129,107		31,476	
Quantity not accounted for	9,276		7,255		7,428	
		218,234		136,362		38,904
Complete year of working	Fourth		Fourth		Supply commenced April 27, 1905.	

Auckland Electric Tramways Co.

The directors' report for 1905 states that the total revenue for the year amounted to £122,995, as compared with £112,429 for the previous year. The traffic receipts, which amounted to £121,879, show an increase of £11,306 over the previous year. After deducting all expenses chargeable to revenue, including £14,255 for interest on the debenture stock of the company, and providing for the rental and percentage of profits payable to the Auckland City Council amounting to £2,684, and after setting aside £13,950 to meet depreciation, there remains a surplus of £20,920, making, with the £3,099 brought forward from the previous account, an available balance of £24,018. The directors recommend a dividend at the rate of 7 per cent. per annum on the share capital, absorbing £21,000, and that the balance of £3,018 be carried forward. The reserve and depreciation fund will now stand at £32,000. The total route mileage operated by the company during the year, viz., 18·64 miles, has remained unaltered, while the passengers carried have increased by 1,743,342 (making 19,789,045). The average receipts per passenger in 1904 were 1·47d., and in 1905 1·46d.; the average expenditure per passenger in 1904 was 0·89d., and in 1905 0·86d.; the proportion of expenses to receipts was only 58 per cent., against 60 per cent. in 1904. The number of cars in service at the end of the year was 55, as compared with 47 at the end of the previous year. To meet the increasing requirements of the traffic five additional cars have since been ordered, the bodies for which are being built in Auckland. An agreement has been entered into with the Mount Eden Road board to construct an extension of the company's system, of about three miles in the district of that authority, and the necessary order in council is expected to be issued shortly. The directors are of opinion that this extension will prove a remunerative addition to the company's undertaking. The difficulty in connection with the subsidences which occurred in certain parts of the track has not yet been overcome. The matter has been receiving careful consideration, and measures have now been decided upon which there is every reason to believe will be effective.

Mr. C. G. Tegetmeier presided at the annual meeting held on Tuesday at Donington House, London. In moving the adoption of the report, he said it showed very satisfactory results, which pointed clearly to the continued progress of the company. Their prosperity had more than realised the anticipations which were formed when the company was started. The route mileage remained unaltered (18·64 miles), and this was the first year that they had had a full year's working. The traffic receipts had been £6,500 per route mile. The short extension of about half a mile had not yet been constructed, the completion of arrangements with the local authorities having caused delay, but the work was now in hand and would be completed shortly. They had recently agreed to construct a further three miles extension, to be completed within three years from the receipt in London of the necessary order in council; it would be here very shortly. It had been said that tramway extensions were the ruin of tramway enterprises, but the directors had not agreed to do this one without very full consideration, and without feeling satisfied that it would prove remunerative. The capital expenditure now stood at £583,834, an increase of £13,414 during the year. Of that amount £3,339 represented the cost to the company of the settlement of the action brought against the company by the original promoter of the concession in respect of engineering fees and other services. The B.E.T. Co. in recognition of an equitable rather than a legal obligation, had agreed to pay one-fourth of the total amount involved, and their share was £1,113. At the end of the year there were 55 cars in stock, but eight added during the year were not conferring their full benefit until the latter months of the year. Five further cars had had to be ordered, and this order had been placed in Auckland. They had one car built there last year, and were very pleased that the result had enabled them to make use of local industry for the supply of their needs in this direction. They ran 109,181 more car-miles and carried 1,743,342 more passengers than in the preceding year. It was satisfactory to find that the increase in the car-mileage run was accompanied by an increase in the average receipts per car-mile and a decrease in the expenses. The population of Auckland and suburbs was about 70,000 persons, and during the year they carried these more than 280 times, and received in fares an amount equal approximately to £1 14s. per head of the men, women and children in the community. On Christmas Eve they carried 109,000 passengers. These figures were altogether in excess of the results they were accustomed to, or even hoped for, in this country. The explanation must be sought in the very different social conditions which prevail in New Zealand. Whatever might be said of the tendency of New Zealand legislation of recent years, there could be no doubt that it had resulted in, or had been accompanied by, a very great increase in the material welfare of the people which was unquestionably far in advance of anything prevailing in this country. The high rate of wages paid provided the worker with a margin over and above his expenditure on absolute necessaries. The eight-hours universal work ng day and the numerous holidays gave ample leisure for recreation and the splendid climate induced everybody to seek his recreation in the open air. Further, the New Zealander, in common with all colonials, had a deep-rooted aversion to walking. It was, therefore, not difficult to account for the extent to which the facilities that they provided were taken advantage of. In summarising the financial result and the board's recommendations, the chairman referred to an item of £17,554 for repairs and maintenance. Although this included several exceptional items, they could not expect much reduction, if any, in that amount, in the future. It was only natural that such expenditure would tend to increase with the increased life of the undertaking. The system was worked to a high degree of its capacity; the 20 millions of passengers were carried last year by an average of less than 50 cars in service, and each working car averaged throughout the year 150 miles per day. Under these conditions the wear and tear on the permanent-way, rolling stock and the electrical equipment, must be correspondingly great, and the cost of all materials and labour used in repairs and maintenance was very much greater than in this country. They were setting aside £13,950 out of revenue to meet depreciation, and they proposed to adopt a policy of making annual provision for this purpose. Ordinary expenditure on repairs and maintenance and expenditure necessary to keep the whole of the undertaking in first class order and condition was provided for out of the current year's revenue, but there came a time sooner or later when extraordinary repairs for renewals and reconstructions had to be incurred. Every year brought this time nearer, and the directors considered it not only desirable but necessary that each year's revenue should be charged with a contribution towards a fund which would enable them to meet such extraordinary expenditure when the need arose. An instance of the expenditure of this nature which would have to be incurred shortly appeared in the report, where it referred to subsidences in certain parts of the track. He referred to this matter last year when it was thought that the repairs they had effected would be lasting, but that had not proved to be the case, and after full consideration with their engineer on the other side they had concluded that the best, and probably in the long run the cheapest, method of overcoming the difficulty would be by a system of pile-driving at that portion of the track where the subsidences occurred. This operation was confined to a distance of about 600 route yards. The cost was estimated at a cost of about £11,000, and they would find the benefit of having a depreciation fund which could be made available for such exceptional expenditure. Another consideration to be borne in mind was that the tenure of the lines might be terminated by the purchase by the local authorities in 26 years in the case of the city lines, and 28 years in the case of the suburban. That was a reasonably long tenure, and although the price to be paid in the event of the purchase was the value of the undertaking as a going concern, it was only prudent to build up a fund which, in any event, would ensure the return of their capital. The percentage of profits payable to the City Council had been calculated on the same basis as in previous years. The agreement with the Council provided that the Council should receive a share of the annual net profits made within the city, and the expression in the agreement was "the annual net profits made and available for distribution." The percentage payable was 5 per cent. upon the profits up to £5,000 per year, and 10 per cent. on any profits in excess of that amount. In arriving at the amount upon which that percentage had to be calculated, they deducted the amount set aside for depreciation and reserve. The Council did not agree with that course, and claimed that they were entitled to their full percentage before any such allocation was made. They could not believe that the claim of the Council could be successfully maintained, for they contended that net profits available for distribution could only mean the balance of the receipts over expenditure after making due provision for depreciation and shrinkage in capital value. The word "net" was intended to express the balance after making all charges and allowances of whatever description, they contended. If the Council were unable to alter their views, he saw no other method of settling the matter but through the law courts.

The board wished to express its appreciation of the services of the local staff. Mr. Hansen had been in charge of the undertaking since its commencement, and to his zeal and ability very much was owing. Mr. Carey, their able engineer, visited London last year, and discussed with the board many matters connected with his department.

Mr. Shireff Hilton seconded the motion, and it was adopted.

Mr. Tegetmeier was re-elected a director, and the auditors were also re-elected.

A Shareholder asked whether the interest could be paid half-yearly, and the Chairman said that the board had considered the matter, and there was every desire to meet what would no doubt be the wish of the shareholders.

The meeting closed with the customary vote of thanks.

Leamington and Warwick Electrical Co.

The annual meeting was held in London on Wednesday last week. The directors' report stated that the tramways had been reconstructed as a double track and electrically equipped for working by electric traction. The power station has been completed, and was supplying energy to the tramways and to other consumers for lighting and power. The capital expenditure during the year amounted to £50,461, of which £40,579 was incurred in connection with the electric tramways reconstruction and equipment, and £9,881 in connection with the equipment for supply of electricity. The necessary funds were advanced by the B.E.T. Co. The directors propose shortly to make an issue of capital in order to discharge the liabilities incurred on capital account. The working accounts show a credit balance of £2,878 from traction, and £141 from electric supply, and sundry receipts amount to £33. The total amount available for distribution is £1,814. There is placed to depreciation and reserve account £566; dividend on the 5 per cent. cum. pref. shares, £77; dividend at the rate of 4 per cent. on the ordinary shares for the year 1905, £634; balance carried forward, £537 2s.

The horse tramways were shut down for reconstruction on March 15th, and working by electric traction was commenced on July 15th, 1905. Between these two dates a service was continued by means of horse omnibuses. The working by horse traction up to July 15th, 1905, resulted in a loss, which, under the circumstances, was unavoidable. The subsequent profits from electric traction would have been larger had it been possible to obtain delivery of more cars during the summer months, only six cars out of the twelve ordered and subsequently delivered being in service during the summer months. A service of motor-omnibuses between Warwick and Leamington was instituted during the early part of 1905 by another company, but this service ceased to run shortly after the commencement of electrical working of the tramways. The supply of electricity commenced on July 14th, 1905.

Coventry Electric Tramways Co.—The annual meeting was held on Wednesday last week in London. The net earnings for the year amounted to £6,598—an increase on the previous year of £3,187. In December an interim dividend of 2½ per cent. was paid, and there remained a balance of £2,564. The directors recommended an additional ½ per cent. dividend, leaving £1,850 for depreciation and £64 to carry forward. During the year the company's indebtedness to the New General Traction Co., Ltd., was reduced by £2,000, and a further sum of £1,350 was about to be paid. Though the dividend had only been increased from 2 to 3 per cent., the reserve had been increased from £1,500 to £3,350. The report was adopted.

Southport Tramways Co.—The report for 1905 shows that, after paying rental of lines and interest charges, there is a loss of £709. An annual payment of £1,053 has been made to the Southport Corporation towards the maintenance, repair and renewal of the permanent way and electrical equipment within the Borough of Southport. A sum of £1,200 has been charged in the accounts, and is payable to the B.E.T. Co. for interest on money advanced to this company in 1902 and 1903 for the purchase of shares in the Birkdale District Electric Supply Co. This investment has in previous years produced no return, but the Birkdale Co. is now being worked at a profit. The working of the tramways, as apart from the company's investment in the lighting company, shows a profit of £490.

River Plate Electricity Co.—The report for 1905 shows a net revenue, after providing for debenture interest and depreciations, of £11,878 plus £3,265 brought forward. The dividend on the 6 per cent. preference shares, requires £6,000, £4,000 has been added to the contingency fund, £867 applied in liquidating the expenses in connection with the acquisition of the Government's interests in the La Plata station, and £4,276 is carried forward. The new station at La Plata is practically completed, and the improvements and extensions at Tucuman have been carried out. There has been a steady growth of business at La Plata throughout the year, but the position and outlook at Tucuman are less satisfactory. The management at Tucuman have had to contend during the last few months of the year with an abnormal rise in the price of fuel, which still continues, and, in addition, a competitive electric station has been erected which is likely to have some injurious effect upon the Tucuman profits in the current year.

Market Drayton Electric Light and Power Co.—Mr. R. C. Donaldson-Hudson presided at the annual meeting last week. The profits on the year's working amounted to £515 in addition to £230 brought forward. The directors decided to write off £38 from the preliminary expenses, to place £362 to the reserve for renewal fund account, and carry forward £346. The chairman remarked that although no dividend was declared, he thought they all would be satisfied with the progress the company had made in the comparatively short time it had been in existence.

Urban Electric Supply.—The report for 1905 states that the profits have amounted to £27,998. After deducting London expenses, debenture interest, interest on loans, &c., there is a balance of £17,111. The amount required to meet the 5 per cent. guaranteed divideeds on the issued capital of the company is £24,702, and the sum required for this purpose in excess of the above balance of profit—namely, £7,591—has been provided by Edmundson's Electricity Corporation, Ltd., under their contract. Under the terms of this contract provision for depreciation will commence after the year 1906. During the year 20,000 preference shares and 30,000 ordinary shares have been issued. During the year Mr. J. C. Wigham resigned his position as director, and Mr. Henry Wolfenden was elected in his place. The annual meeting of the company was held yesterday.

Weston-super-Mare and District Electric Supply Co.—The report for 1905 states that there is a credit balance of £3,169 from the electricity supply and £3,598 from traction, and interest and sundry receipts amounted to £94, totalling £6,861. Deducting expenses, and adding the balance brought forward, there is available £7,697. It is proposed to transfer to credit of depreciation and reserve fund £500, to pay 6 per cent. on the cumulative preference shares, and at the rate of 4 per cent. per annum on the ordinary shares, carrying forward £2,122. The electric supply connections during the year show an increase of 16 per cent. The directors hope to put in hand during the current year an important scheme of mains extensions. An addition to the power station plant will also be necessary. The tramway traffic receipts continue to show a satisfactory increase, the total being £552 in excess of the previous year. The annual meeting was held yesterday.

Stock Exchange Announcements.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

British Columbia Electric Railway Co., Ltd.—Further issue of £100,000 deferred ordinary stock.

And to allow the following to be quoted in the Official List:—

Costa Rica Electric Light and Traction Co., Ltd.—Further issue of £37,100 5 per cent. first debentures, Nos. 2,201 to 2,556 of £100 and 1,601 to 1,630 of £50 each.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.—£400,000 4 per cent. debentures of £100 each, Nos. 1 to 4,000.

United Alkali Co., Ltd.—Further issue of £163,440 5 per cent. mortgage debenture stock, and 10,000 ordinary shares of £10 each.

The Committee has ordered the undermentioned to be quoted in the Official List:—

South Metropolitan Electric Light and Power Co., Ltd.—Further issue of 16,300 shares of £1 each, fully paid, Nos. 103,701 to 120,000; 32,600 7 per cent. cumulative preference shares of £1 each, fully paid, Nos. 235,269 to 267,968; and £51,708 first debenture stock.

Reading Electric Supply Co.—For 1905 the directors recommend a dividend of 5 per cent. per annum on the ordinary shares, carrying forward £838.

Wrexham and District Electric Tramways Co.—The total revenue for 1905 amounted to £5,435, and the expenditure to £4,123, leaving a profit of £1,311, which, with the amount of £1,892 brought forward from the last account, makes an available balance of £3,204. The directors recommend that this should be applied as follows:—To depreciation and renewals account, £500; dividend of 6 per cent. for the year on the cum. preference shares, £1,500; carry forward, £1,204.

Eastern Extension, Australasia and China Telegraph Co.—The report for the half-year ended December 31st, 1905, states that gross receipts have amounted to £317,100, against £331,788 for the corresponding half of 1904. Working expenses, including £16,901 for maintenance of cables, absorb £135,597, against £150,034 for the corresponding period of 1904, leaving a balance of £181,502. The net profit for the half-year is £163,982. After adding £42,081 brought forward, there is an available balance of £206,063. One quarterly interim dividend of 1¼ per cent. has been paid for the half-year, and it is proposed to distribute another of like amount, making, with the interim dividends paid for the first half-year, a total dividend of 5 per cent. It is also proposed to pay a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year 1905; £50,000 has been transferred to general reserve and £21,063 is carried forward.

City of Buenos Ayres Tramways Co. (1904).—The directors have declared a dividend of 1s. 3d. per share for the three months ended March 31st last.

Globe Telegraph and Trust Co.—The directors recommend a dividend of 5s. each on the ordinary shares, making 5½ per cent. for the past year, carrying forward £4,400.

Bordeaux Electric Tramways Co.—A financial contemporary says that the Compagnie Française des Tramways Electriques et Omnibus de Bordeaux has declared a dividend of 6.99 fr. on bearer shares, and 7.20 fr. on registered shares.

MARKET QUOTATIONS.

Wednesday, May 2nd.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	" Nitric	per cwt.	22/-	..
a	" Oxalic	per cwt.	32/-	..
a	" Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal)	per ton	£33 10	..
a	"	per ton	£30	..
a	Bleaching powder	per ton	£5 10	..
a	Bisulphide of Carbon	per ton	£18	..
a	Borax	per ton	£15	..
a	Benzole (90 %)	per gal.	10½d.	..
a	" (50 %)	per gal.	10d.	..
a	Copper Sulphate	per ton	£26	£1 inc.
a	Lead, Nitrate	per ton	£27	..
a	" White Sugar	per ton	£31	..
a	" Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a	Potassium Bichromate, in casks	per lb.	3d.	..
a	Potash, Caustic (75/80 %)	per ton	£20	..
a	Potassium Cyanide	per lb.	7½d.	..
a	Shellac	per cwt.	200/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers	per ton	£6 10	..
a	" Recovered	per ton	£5 10	..
a	" Lump	per ton	£5	..
a	Soda, Caustic (white 70 %	per ton	£10 15	..
a	" Crystals	per ton	£3 5	..
a	Sodium Bichromate, casks	per lb.	2½d.	..
a	" Cyanide	per lb.	7d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots	per ton	£160	..
b	" Wire, in ton lots	per ton	£191	..
b	" Sheet, in ton lots	per ton	£177	..
b	Babbitt's metal ingots	per ton	£43 to £140	..
c	Brass (rolled metal 2' to 12') basis	per lb.	9d.	..
c	" Tube (brazed)	per lb.	10½d.	..
c	" (solid drawn)	per lb.	9¾d.	..
c	" Wire, basis	per lb.	8¾d.	..
c	Copper Tubes (brazed)	per lb.	11½d.	..
c	" (solid drawn)	per lb.	11¾d.	..
g	Copper Bars (best selected)	per ton	£98	£2 inc.
g	Copper Sheet	per ton	£98	£2 inc.
g	" Rod	per ton	£98	£2 inc.
e	" (Electrolytic) Bars	per ton	£92	..
e	" Sheets	per ton	£104	..
e	" Rod	per ton	£95	..
e	" H.C. Wire	per lb.	11d.	..
e	"	per lb.	8/8	..
f	Ebonite Rod	per lb.	8/-	..
f	" Sheet	per lb.	1/7	..
n	German Silver Wire	per lb.	6/- to 7/-	..
h	Gutta-percha, fine	per lb.	5/2⅝ to 5/3⅝	inc.
h	India-rubber, Para fine	per lb.	£18	..
i	Iron, Charcoal Sheets	per ton	50/-	1/9½ inc.
i	" Pig (Cleveland warrants)	per ton	From £11	..
i	" Forgings, according to size	per ton	47/6 to 50/-	..
i	" Scrap, heavy	per ton	£9 15	..
i	" Wire, galvanised No. 8	per ton	£16 5 to £16 7 6 / £18 2 6 to £18 5	..
g	Lead, English Ingot	per ton	8/-	..
g	" Sheet	per ton	£7 5	..
m	Manganin Wire No. 28	per lb.	6d. to 1/-	..
g	Mercury	per bot	2/6 to 4/-	..
d	Mica (in original cases) small	per lb.	4/6 to 8/6	..
d	" " " medium	per lb.	1/1 to 1/3	..
d	" " " large	per lb.	1/1½ to 1/3	..
p	Phosphor Bronze, plain castings	per lb.	1/4	..
p	" rolled bars & rods	per lb.	91/6	..
p	" strip & sheet	per lb.	1/- to 1/1	..
o	Platinum	per oz.	£58	..
e	Silicium Bronze Wire	per lb.	£15 to £40	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£182 to £182 10	£5 inc.
	" in bars		2/1	1½d. inc.
g	Tin, Block	per ton	£46 to £70	..
n	" Wire, Nos. 1 to 16	per lb.	8d.	..
p	White Anti-friction Metals—		5½d.	..
	"White Ant" brand	per ton	4½d.	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	4¾d.	..
j	" 6 lea. Flax	per lb.	£11	..
j	" 8 ply 10 lbs. Russian	per lb.	£30 5	10/- inc.
j	" 10 lbs. Russian, single	per ton		
j	" 180 lbs. Jute rove	per ton		
k	Zinc, Sh't (Vieille Montagne bnd.)			

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
j Walter H. Hindley & Co., Ltd.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Norwegian Water Power.—H.M. Minister at Christiania (Sir A. J. Herbert, K.C.V.O.) reports that there has recently been considerable agitation against the water power of Norway passing into the hands of foreigners, and that a Bill has been hastily passed forbidding the sale of waterfalls to foreigners, who in future are only to be allowed to lease them. A Bill dealing more fully with the subject will, it is stated, shortly be introduced, in which, in addition to the above conditions, the lease of any waterfall to a company is rendered illegal unless half the capital of the company is Norwegian.—*Board of Trade Journal.*

Bank Rate Altered.—The Bank rate was yesterday altered to 4 per cent.

STOCKS AND SHARES

Wednesday Afternoon.

Budget statements seldom affect the departments with which we are especially concerned in these columns. They exercise a kind of indirect influence, through their power over Consols, which has a sympathetic effect upon investment securities generally, but this time the necessarily humdrum character of Mr. Asquith's first performance has had little influence upon anything. Electric Lighting shares remain in their steady, comatose condition, Telegraphs on the whole are rather harder, while the feature in the Railway list is the extreme weakness of Metropolitan and Metropolitan District stocks.

May the First being a holiday sacred to sweeps and the Stock Exchange, business has had an extra excuse for suffering since last we wrote, and some excuse, unfortunately, was very necessary to explain the continued lack of orders in Capel Court. Some of the new issues of which mention has already been made here, are approaching fruition, but the inclemency of the financial season may nip several in the bud. The defence of the Electrobus people to the slating which the newspapers gave them has been followed by notice in certain journals that the shares have since changed hands at 2s. 6d. discount. Nominally the price is ¼ to ⅛ discount. The new Amalgamated Motor-'Bus shares are not regarded with much enthusiasm, the business being so obviously overdone. Yet another company, with an Anglo-French title, is coming soon.

Under the threat of the L.C.C. competition, now being considered by a Select Committee, statistics relating to the financial position of the various metropolitan electric lighting companies are manifestly valuable. The list published here last month of the amount per cent. that each company had applied to depreciation and written off out of revenue on the average capital employed during 1905, may be supplemented by figures showing the amounts at the credit of depreciation and reserve accounts. Keeping to the year ended 1905, the largest sum has been accumulated by the Metropolitan Electric Supply Company, which shows £236,000 in this way, with nearly 10 per cent. more as premiums on new issues. The St. James' and Pall Mall has no depreciation account, the amount for this charge being written off annually, but the company has a reserve fund of £66,529, its issued capital being £450,000, including Debenture stock. The City of London had £196,320 to the credit of its depreciation and reserve accounts, the County of London (Metropolitan) £52,453, which was £6,000 less than that of the Kensington and Knightsbridge, while the Brompton and Kensington had £57,600, and the Chelsea £53,513. The West-End undertaking of the Charing Cross Company possessed £78,300, plus £20,000 for leasehold depreciation and £96,600 for premiums on new issues.

Decreased receipts are compensated by lower expenditure in the Eastern Extension Telegraph Company's report. The dividend, as indicated earlier, is maintained at 7 per cent. Several other reports of interest are out this week. The Great Northern Telegraph of Copenhagen Company announces in its report that the contract for the cable to Iceland has been given to the Telegraph Construction and Maintenance Company. The line has to be completed and opened by October 1st next at the latest. The Great Northern paid 24 per cent. for the year, but the price is easier at 39. Globe Telegraph and Trust Ordinary will receive 5s., making 5½ per cent. for the whole year, and £4,400 is carried forward. This has put the price ⅛ better at 11⅛. After rising well above 23, Anglo-American Deferred fell a shade to 22⅞, although this leaves them ⅜ up on the week. Callender's are better at 11⅛.

Nothing sensational has taken place in the Traction group. Buenos Ayres Grand National "A" Preference are a trifle better at 7 1/16, possibly upon the company's Bill, which has come before the House of Lords this week. Calcutta Trams rose ⅛ to 9¼, Potteries Preference fell ¼ to 9, and Belgrano Ordinary ⅛ to 3⅜. The Kalgoorlie Electric Tramways report is not brilliant by any means, although the prospects seem to be moderately encouraging.

Falling Home Railway stocks follow the lead set by Consols, which slumped to-day, Wednesday, upon the withdrawal of money from the market by insurance companies interested in the San Francisco disaster. The principal stocks were all flat, so Metropolitans at 70½ and Districts at 23½ were but participators in the all-round decline. It becomes increasingly difficult to sell any amount of District stock, notwithstanding the economies which have already come into force on the line. Electric stocks are nominally about the same as before, but when a seller appears to test the tone of the market he finds prices less firm than they appear on the surface.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years.				Closing Quotations April 25th.	Closing Quotations May 2nd.	Business done week ended May 2nd, 1906.		Rise + or Fall —
			1902.	1903.	1904.	1905.			Highest	Lowest.	
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3⅜— 4¼	3⅜— 4¼	..	..	..
155,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	83 — 88	83 — 88	84½	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	22½	31½	66 — 68 xd	67 — 69	68	67½	+1
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½	6 %	113½—114½ xd	114 —115	115¼	114½	+ ½
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½	22 — 22½	22⅞ — 23	23 1/16	21 1/16	+ ⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	102¼	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	8 — 8½	7⅞ — 8¼	7 15/16	..	— ⅛
1,982,856	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 98	96⅛ — 98⅛	98	96⅜	+ ⅛
16,000	Cuba Telegraph	10	6¾%	10 %	5 %	5 %	8⅜ — 9½	8¼ — 9 xd	9⅛	8⅜	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18 xd	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8¼ — 9	8½ — 9	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103%	100 —103 %	..	..	..
60,710	Direct United States Cable	20	8½%	8 %	8½%	8⅜%	15⅛ — 15⅜	15⅛ — 15⅜	15 1/16	15⅜	..
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	144 —147 xd	143 —146	145	143½	—1
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	89 — 91 xd	89 — 91	90½	89½	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107⅜—109½	106 —108 xd	107½	..	..
800,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	7 %	14½— 15½	14½— 15	15½	14⅜	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½—107½	105½—107½	..	..	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103 %	101 —103 %	101	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅜%	5½%	10⅜— 11⅛	11 — 11½	11⅛	10⅞	+ ⅛
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜— 15	14⅜— 15⅛	14 3/16	14 1/8	+ ⅛
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	40 — 42	38 — 40	40	..	— 2
42,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	18 %	13 %	58½— 60½	58 — 60	58½	..	— ½
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1⅛— 1⅜	1⅛— 1⅜	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	8 %	4 %	..	1⅜— 1 7/16	1⅜— 1 7/16 xd	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	¹⅞— 1	¹⅞— 1 xd	..	..	..
1,988,388	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —110	108 —110	109	108	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	109½—111½	108 —110	110½	108½	—1½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14	12 — 14	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½— 12½	10½— 12½	12 1/16	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5½— 5⅝	5½— 5⅝	5 1/16	5 1/16	..
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	8½%	8½%	8½%	8½%	98½—100½	98 —100	98½	..	— ½
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105	103 —105	104½	103½	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7½%	1⅜— 1½	1⅜— 1½	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1½— 1⅝	1½— 1⅝	26/6	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	98 —100	99 —101	100½	99⅝	+1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..
11,839	Reuter's	8	5 %	5 %	5 %	5 %§	7½— 7⅞	7½— 7⅞	7 11/16	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	103 —106	103 —106	..	..	..
3,201	Submarine Cables Trust	Certs.	6 %	6 %	6 %	6 %	126 —129	126 —129 xd	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7½	7 — 7½	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜— 5½	5⅜— 5⅝	..	..	— ⅛
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —112	110 —112	..	..	..
15,609	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜— 10⅛	9⅜— 10⅛	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	⅜— ½	⅜— ½	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	5 %	14 — 14½	14 — 14½	14½	14⅜	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —103	100 —103	102⅔	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜— ½	⅜— ½	14/6	14/3	..
84,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	6 %	8¼— 8½	8¼— 8½	8⅜	8¼	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6½— 7⅛	6½— 7⅛	..	..	..
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	8¼— 8⅜ xd	8¼— 8⅜ xd	8⅜	8 5/16	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅛— 6⅛	5⅛— 6⅛	6 1/16	5 1/16	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	140 —143	140 —143	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
800,000	Babcock & Wilcox, 1 to 590,000	1	..	17 %	20 %	20 %	3⅞— 4¼	3⅞— 4	79/4½	76/10½	— ⅛
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1¼— 1⅜	1¼— 1⅜ xd	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	2⅛— 2 3/16	2 1/16— 2 3/16	..	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6 — 6½	6 — 6½	6½	6 13/32	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5½— 5⅝	5½— 5⅝	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	3⅞— 4¼	3⅞— 4¼	..	..	..
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	102 —106	102 —106	..	..	..
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	120 —123	116 —119 xd	117	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —113	110 —113	110½	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	101 —103	101 —103	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	102 —105	103 —106	..	..	+1
133,301	British Electric Traction	10	8 %	6 %	6 %	6 %	6 — 7	6 — 7	6⅜	6 5/16	..
161,497	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	8⅝— 9⅜	8⅝— 9⅜	9 1/16	..	..
1,415,423	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	111 —114	112 —115	113¾	112½	+1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	96½— 98½	93 — 95 xd	96	94	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6¾— 7	6¾— 7	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞— 6⅛	5⅞— 6⅛	..	..	..
600,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	103 —106	104 —107	..	..	+1
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅞— 2⅛	1⅞— 2⅛	41/3	40/-	..
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	80 — 85	80 — 85	81	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅞— 1 1/16	⅞— 1 1/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	⅜— 1 xd	⅜— ½	14/-	..	— ⅛
150,000	Do. Non-cum. 6 % Pref. ..	2	6 %	6 %	6 %	6 %	1¼— 2 xd	1¼— 2	..	..	..
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	97½	97¼	..
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	84 — 86	84 — 86	84½	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3⅜— 3⅝ xd	3½— 3⅝	68/1½	67/6	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅝— 5¾ xd	5⅝— 5¾	5⅝	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5⅛ xd	5 — 5⅛	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 —108	106 —108	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8⅜— 9¼ xd	9 — 9¼ xd	9 3/32	..	+ ⅛
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	8¼— 9	8¼— 9	..	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	106 —108	106 —108	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10½— 11½	11 — 12	11½	10¾	+ ½
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜— 6	5⅜— 6	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108½—110½	108½—110½	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅜— ½	⅜— ½	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	..	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	95 —100	95 —100	..	..	..
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	90 — 92	90 — 92	90⅝	..	..
530,316	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	100 —102	100 —102	100½	..	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	81 — 84	80 — 83	82	..	—1
1,480,000	City and South London Railway	Stock	3½%	3⅝%	2½%	1¾%	41 — 43	41 — 43	42¾	..	..
85,000	Crompton & Co., Nos. 1 to 85,000	£	5 %	2½%	2½%	..	2 — 2¼	2 1/16— 2 3/16	..	..	+ 1/16
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	96 — 99	..	..	+1

period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(Continued).

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(continued).

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations April 25th.	Closing Quotations May 2nd.	Business done week ended May 2nd, 1906. Highest	Lowest.	Rise + or Fall−
260,000	Dick, Kerr & Co., 1 to 260,000	† 1	..	..	10 % ..	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1⅞ — 1⅞	1⅞ — 1⅞	26/3	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	104 —107	104 —107	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	6⅔ %	6 %	6 %	13⅜ — 14⅜	13⅜ — 14⅜	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14⅜ — 15⅜	14⅜ — 15⅜	..	..	..
68,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99⅝ —100⅜	99⅝ —100⅜	..	..	..
800,000	Do. 3½ % "A" Debs.	100	..	3½ %	3½ %	3½ %	97⅛ — 98	97⅛ — 98⅜	..	..	+ ⅛
800,000	Do. 3½ % "B" Deb. Stock	100	..	3½ %	3½ %	3½ %	96⅜ — 97⅛	96⅜ — 97⅛	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261	£ 5	Nil	Nil	2½ 6/8	..	1⅝ — 1⅞	1½ — 1⅝	..	..	— ⅛
17,189	Do. "A" shares, 01—017,189	£ 5	Nil	Nil	2½ 6/8	..	2½ — 3	2½ — 3	51/10½	..	..
844,023‡	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000‡	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	92	..	..
112,100	Electric Construction 1 to 112,100	£ 3	6 %	4 %	Nil	..	⅝ — 1⅜	⅝ — 1⅜	..	..	..
81,390	Do. do. 7 % Cum. Pref., 1 to 81,390	£ 3	7 %	7 %	7 %	..	2 — 2½	2 — 2½	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9⅜ — 9⅞	9⅜ — 9⅞	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	..	94 — 98	94 — 98	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	4 — 4½	3⅝ — 4½	81/3	..	— ½
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10⅜ — 11¼	10⅜ — 11¼	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —104	100 —102	..	..	−2
200,000	Henley's (W. T.), Telegraph Works, Ord.	£ 5	20 %	15 %	15 %	15%	12¼ — 13¼	12⅛ — 13⅛	..	..	..
200,000	Do. do. 4½ % Pref.	£ 5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
41,978	Do. do. Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	109 —111	109 —111	..	..	..
108,022	Do. do. Scrip. 50 % paid	..	..	..	..	..	57⅛ — 59½	57⅛ — 59½	59	58⅜	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10%	5 %	10%	17⅛ — 18¼	17 — 18	17⅜	..	— ⅛
37,500	†Liverpool Overhead Railway, Ord.	10	1⅝%	1⅝%	1½%	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6½ — 7	6½ — 7	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	6 — 8	7⅛ — 8½	..	..	+1
899,930	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	3 %	1 — 2	1½ — 2½	..	..	+ ½
'125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	9½ — 10	9½ — 9⅝	9⅝	9½	— ⅛
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	96 — 90	96 — 99	97⅛	97	— ½
314,016	Metropolitan Electric Trams, Defd.	£ 1	Nil	Nil	Nil	3 %	½ — ½	½ — ½	3/6	..	..
500,000	Do. 5 % Cum. Pref.	£ 1	5 %	5 %	5 %	5 %	¾ — 1	¾ — 1	18/9	17/6	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	102 —104	102 —104	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	£ 5	..	..	6 %	6 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	8 — 9	8 — 9	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	9 — 9½	8⅜ — 9½	..	..	— ⅛
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 — 106	103 —106	..	..	..
37,350	Telegraph Construction and Maintenance	£ 12	20 %	20 %	15 %	15 %	33 — 35	33 — 35	34	..	..
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	101 — 103	101 —103	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	97 — 99	97 — 99	97	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	100 — 103	100 —103	102½	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	£ 5	8⅓%	3 %	Nil	Nil	1⅜ — 2¼	1⅜ — 2¼	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	£ 5	..	6 %	Nil	Nil	3⅜ — 4	3⅜ — 4	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	80 — 85	80 — 85	80	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	£ 5	..	5 %	5⅛%	4 ⅝%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	103 —106	101 —104 xd	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	£ 5	8 %	10 %	10 %	10 %	8¾ — 9¼	8¾ — 9¼	..	..	..
10,623	Do. do. 7 % Cum. Pref.	£ 5	7 %	7 %	7 %	7 %	9¼ — 9¾	8¾ — 9¼	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..
80,000	Charing Cross and Strand Electricity Supply	£ 5	10 %	8 %	8 %	5 %	4 — 5	4 — 5	85/-	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	£ 5	4½%	4½%	4½%	4½%	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	£ 5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
40,000	Do. do. 1908	£ 5	..	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..
44,436	Chelsea Electricity Supply, Ord.	£ 5	4½%	5⅛%	6 %	6 %	5½ — 5⅝	5⅛ — 5⅝	..	..	..
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10½ — 11	10¼ — 11	10⅞	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	13 — 14	13 — 14	..	..	..
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
40,000	County of Durham Electrical Power, Ord.	£ 2	4 %	4 %	£3 7 0	4 %	2⅝ — 3⅛	2⅝ — 3⅛	..	..	..
50,000	Do. do. do. 5 % Pref.	£ 5	5 %	5 %	5 %	5 %	5 — 5⅜	5 — 5⅜	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8 — 9	8 — 9	..	..	..
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11½ — 12½	11½ — 12½	..	..	..
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	109	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	99 —101 xd	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	£ 5	7 %	7 %	7 %	5 ⅝%	3¾ — 4¼	3¾ — 4¼	..	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	5 — 5½	5 — 5⅝	5⅝	5½	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	103 —106	103 —106	104	..	..
10,000	Folkestone, 1 to 10,000	£ 5	..	5⅓%	5⅓%	5⅓%	5⅛ — 5⅝	5⅛ — 5⅝	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	£ 5	..	..	..	5 %	5 — 5½	5 — 5⅝	5⅜	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	103½	103	..
13,000	Hove, 1 to 13,000	£ 5	..	8½%	8½%	9 %	8¾ — 8¾	8¾ — 8¾	..	..	..
10,000	Do. New (£5 10s. paid)	£3	..	8½%	8½%	9 %	8¾ — 8¾	8¾ — 9	..	..	+⅛
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —101	98 —100	..	..	—
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98 —101	98 —100	..	..	—
21,000	Kensington and Knightsbridge Electric Ord.	£ 5	10 %	12 %	12 %	10 %	9¼ — 10¼	9¼ — 10¼	..	..	+⅛
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	£ 3	Nil	Nil	3 %	4 %	2 — 2½	2 — 2½	..	..	..
60,000	Do. do. do. 6 % Pref.	£ 5	6 %	6 %	6 %	6 %	5 — 5⅜	5 — 5⅜	5⅞	..	..
874,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	£ 5	7½%	8½%	10 %	10 %	8¾ — 9¼	8¼ — 9¼	8⅛	8⅛	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	£ 5	4½%	4½%	4½%	4½%	5¼ — 5⅝	5¼ — 5⅝	..	..	..
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	£ 5	..	8 %	8 %	8 %	7¾ — 7¾	7¼ — 7¾	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	£ 5	..	5%	5 %	5 %	6 — 6½	6 — 6½	..	..	..
10,852	Notting Hill Electric Lighting	£ 10	6 %	6 %	7 %	7½%	13 — 14	13 — 14	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	£ 5	..	6¾%	7 %	7 %	6½ — 7	6½ — 7	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£ 5	14½%	14½%	14½%	12½%	9 — 10	9 — 10	..	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	£ 5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£ 5	2½%	4 %	4 %	4 %	2½ — 2⅝	2½ — 2⅝	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	£ 5	12½%	8 %	4 %	4 %	8 — 8½	8 — 8½	..	..	..
108,700	South Met. Elec. Lt. & Power (Ord.	£ 1	Nil	Nil	Nil	2½%	⅜ — ⅝	⅜ — ⅝	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	£ 1	Nil	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	£ 5	5 %	5 %	5 %	5 %	4⅜ — 4⅝	4⅛ — 4⅝	..	..	..
30,000	Do. do. 5 % Cum. Pref.	£ 5	5 %	5 %	5 %	5 %	5 1/16 — 5 3/16	4⅛ — 5 3/16	5	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	102 —104	102 —104	103	102	..
110,000	Westminster Electric Supply, Ord.	£ 5	12 %	12½%	14 %	13 %	9½ — 10½	9½ — 10½	9 13/16	9⅜	..
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	£ 5	5 %	5 %	5 %	5 %	5 1/16 — 5 3/16	5 1/16 — 5⅜	5⅜	..	..

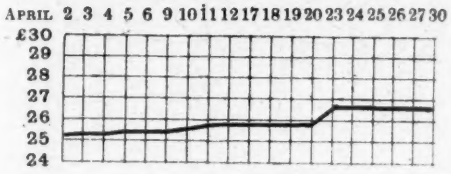
Shares not officially quoted :—Mackay Companies, ord., 65—66. Pref. 73—74.
† Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

(Bank rate of discount 3½ per cent. (April 5th, 1906).

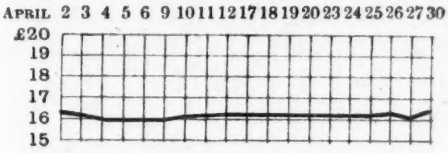
METAL MARKET.

Fluctuations in April.

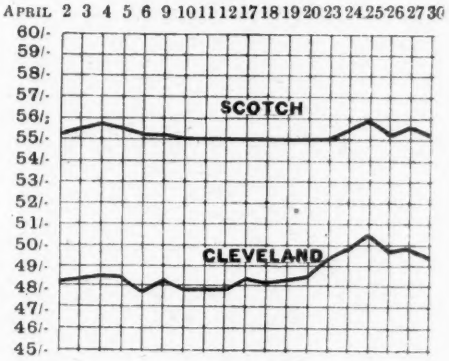
SPELTER (G.O.B's.)



LEAD (ENGLISH)



IRON.



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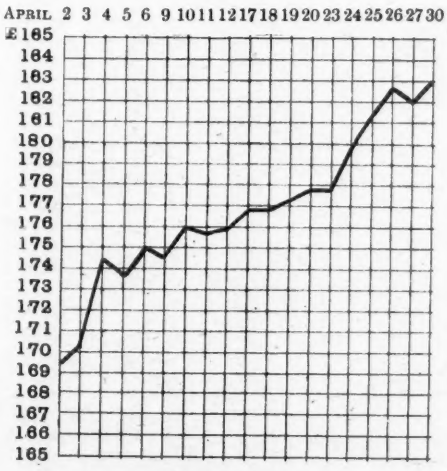
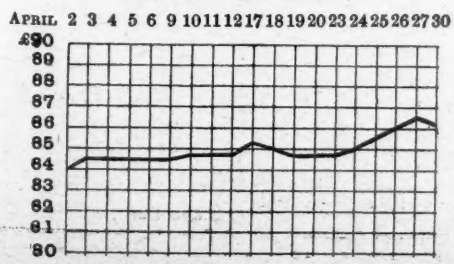


COPPER (G.M.B's.)



THE ADVANTAGES OF EMPLOYING ELECTRICAL ENGINEERING NOMENCLATURE IN STEAM ENGINEERING CALCULATIONS.

By H. M. HOBART.

(*Concluded from page* 695.)

A VERY interesting example of the readiness with which electrical engineering calculations may be carried out with this system of units may be found in the calculation of the efficiency of a generating station, this efficiency being defined as the ratio of the KW.-hours delivered from the generating station during a year, to the KW.-hours of calorific value of the coal burned during the year.

Let us carry out this calculation for a representative generating station in England. During the year ending June 30th, 1904, 1·5 million KW.-hours were delivered from this station, and this was employed for lighting and tramways. The load factor was 22 per cent., and the station was run condensing. The coal burned had a calorific value of 7,500 KW.-hours per ton. 6,700 tons were burned during the year; hence the total energy of combustion for the year amounted to—

$$7{,}500 \times 6{,}700 = 50 \text{ million KW.-hours.}$$

Thus the overall efficiency of the generating station was—

$$\frac{1{\cdot}5}{50} = 3{\cdot}0 \text{ per cent.}$$

While this is not a good result, it is nevertheless typical of the great majority of generating stations of this type and capacity. A condensing station of this output should, however, show at least 5 per cent. efficiency. With large modern stations efficiencies of over 7 per cent. are often attained.

Thus for the year ending June 30th, 1904, the efficiency of the Berlin electricity works, with an output of 113 million units from a number of distributed generating stations, works out at 8·8 per cent. The generating station of the Glasgow Corporation tramways for the year ending May 31st, 1905, and with an output of 23 million units was 8 per cent. The Sheffield Corporation tramways for the same year had an output of 9·4 million units from the generating station, and an efficiency of 6·1 per cent.

From the various sources from which this data was brought together, it appeared that the average price paid for coal, and the calorific value of the coal used in these plants, was as shown in Table V.

TABLE V.

—	Cost of coal in shillings per ton.	Calorific value in KW.H. per ton.
Berlin Electricity Works... ...	16·0	8,100
Glasgow Corporation Tramways...	6·4	8,100
Sheffield Corporation Tramways...	8·2	7,700

From the data in Table V. we may deduce, as in Table VI., the fuel cost per KW.-hour of calorific value of the coal, and then dividing by the efficiency, also the fuel cost per KW.-hour of output from the generating stations.

TABLE VI.

—	Cost per KW.-hour of calorific value in pence.	Efficiency of generating station or stations.	Fuel cost per KW.-hour output from generating stations in pence.
Berlin Electricity Works ...	0·0237	8·8	0·27
Glasgow Corporation Tramways	0·0095	8·0	0·12
Sheffield Corporation Tramways	0·0127	6·1	0·21

Given the cost of coal in shillings per ton, its calorific value in KW.-hours per ton, and the efficiency of the gene-

Absolute Pressure in Kgs per Sq. Cm.	Temperature of Saturated Steam		Consult these Colums to obtain the Energy in Kilowatt Hours contained in one Ton of Steam						Consult these Colums to obtain the Energy in Kilowatt Hours necessary to raise one Ton of Steam at Constant Pressure						Specific Volume in Cubic Meters per Kg.				Specific Weight in Kgs. per Cubic Meter.			
			Component Parts i.e. Increase in Energy when Heating one Ton of Water						Component Parts i.e. Heat required to raise one Ton of Water						Total Energy i.e. Heat required to raise Steam from one Ton of Water at 0°C							
	Temperature in Centigrade Scale	Absolute Temperature (Centigrade)	Water at 0°C to Water at 212° (Heat in Liquid)	Saturated Steam at 212° to Steam at 302° Superheat	Steam from 302° Superheat to Steam at 392° Superheat	Steam from 392° Superheat to Steam at 482° Superheat	Steam from 482° Superheat to 572° Superheat		Water at 0°C to Water at 212° (Heat in Liquid)	Water at 212° to Saturated Steam at 212°	Saturated Steam at 212° to Steam at 302° Superheat	Steam from 302° Superheat to Steam at 392° Superheat	Steam from 392° Superheat to 482° Superheat	Steam from 482° Superheat to 572° Superheat	Saturated Steam	Steam at 302° Superheat	Steam at 392° Superheat	Steam at 482° Superheat	Saturated Steam	Steam at 302° Superheat	Steam at 392° Superheat	Steam at 482° Superheat
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15	Col 16	Col 17	Col 18	Col 19	Col 20	Col 21	Col 22	Col 23	Col 24	Col 25	Col 26	Col 27	Col 28	Col 29
.05	32	305	32·2	63·9	21·2	21·2	21·2	67·7	60·8	71·0	74·0	32·2	68·0	27·6	27·6	27·6	71·9	76·5	77·4	80·1	28·0	33·4	39·2	42·8	·0337	·03	·0282	·0236
.06	36	309	41·0	63·6	21·2	21·2	21·2	67·8	69·9	72·0	74·1	41·0	67·7	27·6	27·6	27·6	71·8	76·6	77·5	80·3	24·1	28·1	32·1	36·2	·0415	·0334	·0312	·0277
.07	39	312	45·4	63·3	21·2	21·2	21·2	68·0	70·0	72·1	74·2	45·4	67·4	27·6	27·6	27·6	71·9	76·7	77·6	80·4	20·8	24·8	27·7	31·6	·048	·0412	·0362	·0317
.08	42	315	48·9	63·1	21·2	21·2	21·2	68·1	70·1	72·2	74·3	48·9	67·3	27·6	27·6	27·6	72·1	76·9	77·7	80·5	18·4	19·2	21·8	24·5	·060	·0521	·046	·0408
.09	44	317	51·3	62·9	21·3	21·3	21·3	68·1	70·1	72·2	74·5	51·3	67·2	27·7	27·7	27·7	72·2	77·0	77·8	80·6	15·0	17·3	18·7	22·0	·066	·0576	·0508	·0455
.01	46	319	53·6	62·7	21·3	21·3	21·3	68·2	70·3	72·3	74·5	53·6	67·0	27·7	27·7	27·7	72·3	77·1	77·9	80·7	12·3	14·6	16·5	18·5	·0813	·0686	·0606	·0542
.012	49	322	57·0	62·6	21·4	21·3	21·3	68·3	70·4	72·5	74·6	57·0	66·8	27·9	27·7	27·7	72·5	77·2	78·0	80·8	10·8	12·6	14·3	15·9	·0925	·0795	·070	·063
.014	52	325	60·5	62·3	21·4	21·3	21·3	68·3	70·4	72·5	74·6	60·5	66·4	27·9	27·7	27·7	72·6	77·3	78·1	81·0	9·5	11·1	12·6	14·0	·105	·0902	·0795	·0714
.016	55	328	64·0	62·0	21·5	21·4	21·4	68·4	70·5	72·6	74·7	64·0	66·1	28·0	27·9	27·9	72·7	77·5	78·3	81·1	8·5	9·84	11·3	12·3	·117	·1005	·0885	·0814
.018	58	331	67·6	61·7	21·5	21·4	21·4	68·5	70·6	72·7	74·8	67·6	66·0	28·0	27·9	27·9	72·7	77·5	78·3	81·1	7·48	8·84	10·2	11·3	130	1115	·0985	·0885
.02	60	333	69·8	61·5	21·7	21·5	21·5	68·5	70·7	72·8	74·9	69·8	65·8	28·1	28·0	28·0	72·8	77·6	78·4	81·2	7·15	8·25	9·33	10·4	140	1215	·107	·096
.022	63	336	73·4	61·3	21·7	21·5	21·5	68·6	70·7	72·8	74·9	73·4	65·6	28·1	28·0	28·0	72·8	77·6	78·4	81·2	6·63	7·60	8·58	9·58	151	1·31	1·14	·105
.024	65··	338	75·6	61·0	21·8	21·7	21·5	68·6	70·8	72·9	75·0	75·6	65·4	28·2	28·1	28·1	72·9	77·7	78·5	81·3	6·10	7·02	7·94	8·86	164	·1425	·126	·113
.026	66	339	76·8	60·8	21·9	21·7	21·7	68·6	70·8	72·9	75·1	76·8	65·2	28·3	28·1	28·1	72·9	77·7	78·5	81·3	5·70	6·53	7·40	8·23	1·76	1·53	1·35	·122
.028	67	340	78·0	60·7	21·9	21·8	21·7	68·6	70·8	73·1	75·1	78·0	65·1	28·3	28·2	28·1	73·0	77·8	78·6	81·4	5·30	6·11	6·93	7·70	1·84	1·63	1·445	1·30
.03	69	342	80·4	60·6	22·0	21·8	21·7	68·7	71·0	73·2	75·3	80·4	65·0	28·4	28·2	28·1	73·1	77·9	78·7	81·5	4·60	5·29	5·96	6·64	2·18	1·895	1·69	1·51
.035	72	345	83·8	60·4	22·0	21·9	21·8	68·9	71·1	73·3	75·5	83·8	64·8	28·4	28·3	28·2	73·1	78·0	78·8	81·6	4·04	4·63	5·26	5·85	2·46	2·16	1·90	1·71
.04	75	348	87·3	60·1	22·1	21·9	21·8	68·9	71·1	73·3	75·5	87·3	64·5	28·6	28·3	28·2	73·2	78·0	78·9	81·7	3·65	4·17	4·70	5·25	2·74	2·40	2·13	1·91
.045	78	351	90·8	59·9	22·2	22·0	21·9	69·0	71·2	73·4	75·6	90·8	64·3	28·7	28·6	28·3	73·4	78·1	78·9	81·7	3·27	3·78	4·28	4·74	3·06	2·64	2·36	2·12
.05	81	354	94·6	59·5	22·2	22·1	21·9	69·0	71·2	73·4	75·6	94·4	64·1	28·7	28·6	28·3	73·5	78·2	79·0	81·8	2·75	3·18	3·58	3·98	3·66	3·14	2·79	2·53
.06	86	359	100·0	59·2	22·35	22·1	22·0	69·1	71·3	73·5	75·7	100	63·8	28·8	28·6	28·4	73·7	78·4	79·2	82·0	2·38	2·75	3·10	3·44	4·20	3·64	3·22	2·91
.07	90	363	105·0	58·8	22·35	22·2	22·0	69·3	71·5	73·6	75·9	105	63·4	28·8	28·7	28·4	73·9	78·6	79·4	82·2	2·10	2·43	2·72	3·02	4·76	4·10	3·67	3·32
.08	93	366	108·0	58·5	22·45	22·35	2·11	69·4	71·6	73·7	76·0	108	63·1	28·9	28·8	28·6	74·0	78·9	79·7	82·6	1·88	2·14	2·44	2·70	5·32	4·68	4·09	3·70
.09	96	369	112·0	58·2	22·6	22·35	2·11	69·5	71·7	73·8	76·1	112	62·8	29·0	28·8	28·6	74·1	79·1	80·0	82·9	1·70	1·96	2·21	2·44	5·87	5·08	4·53	4·09
1·0	99	372	115·4	57·9	22·7	22·45	2·22	69·5	71·8	74·0	76·2	115	62·6	29·1	28·9	28·7	74·2	79·1	80·0	82·9	1·43	1·66	1·85	2·05	6·84	6·03	5·38	4·80
1·2	104	377	121	57·5	22·8	22·6	22·3	69·6	71·9	74·1	76·3	121	62·3	29·3	29·0	28·8	74·3	79·3	80·2	83·0	1·24	1·439	1·60	1·77	·906	·806	·725	·656
1·4	108	382	124·9	57·0	22·9	22·7	22·3	69·7	72·0	74·2	76·4	124·9	61·8	29·4	29·1	28·8	74·6	79·6	80·5	83·4	1·08	1·27	1·41	1·56	·816	·700	·708	·642
1·6	113	386	131	56·6	23·2	22·8	22·4	69·8	72·1	74·3	76·5	131	61·5	29·6	29·3	28·9	74·7	79·7	80·6	83·5	·958	1·13	1·26	1·40	1·02	·886	·795	·714
1·8	116	389	136	56·3	23·4	22·9	22·6	69·9	72·2	74·5	76·8	136	61·2	29·8	29·4	29·0	74·9	79·9	80·8	83·7	·886	1·02	1·14	1·26	1·13	·976	·875	·794
2·0	120	393	141	56·0	23·6	23·0	22·7	70·0	72·3	74·7	76·9	141	61·0	30·0	29·5	29·1	75·0	79·9	81·0	83·8	·810	·930	1·04	1·15	1·24	1·065	·956	·868
2·2	123	396	144	55·7	23·9	23·2	22·8	70·2	72·5	74·8	77·2	144	60·6	30·3	29·6	29·3	75·1	78·1	81·1	83·9	·746	·864	·962	1·06	1·34	1·155	1·04	·945
2·4	125	398	147	55·5	24·1	23·3	22·8	70·2	72·6	75·0	77·3	147	60·4	30·5	29·7	29·3	75·2	78·3	81·2	84·0	·602	·800	·890	·98	1·45	1·25	1·125	1·02
2·6	128	401	150	55·1	24·4	23·4	22·9	70·3	72·7	75·1	77·4	150	60·3	30·8	29·8	29·4	75·2	78·4	81·4	84·3	·645	·746	·830	·918	1·55	1·34	1·205	1·09
2·8	131	404	154	54·8	24·6	23·5	23·0	70·4	72·8	75·2	77·5	154	60·0	31·0	29·9	29·5	75·2	78·5	81·5	84·5	·605	·700	·780	·858	1·56	1·43	1·28	1·165
3·0	133	406	156	54·7	24·8	23·6	23·2	70·4	72·8	75·2	77·6	158	59·7	31·4	30·2	29·7	75·5	78·6	81·6	84·6	·569	·660	·732	·806	1·76	1·515	1·37	1·24
3·2	135	408	158	54·6	25·0	23·8	23·3	70·5	72·9	75·3	77·6	161	59·5	31·7	30·4	29·8	75·5	78·6	81·6	84·7	·538	·624	·692	·760	1·86	1·615	1·45	1·316
3·4	137	410	161	54·4	25·3	24·0	23·4	70·5	73·0	75·4	77·7	161	58·5	31·7	30·4	29·8	75·6	78·7	81·7	84·8	·510	·588	·664	·720	1·96	1·70	1·51	1·30
3·6	139	412	163	54·1	25·5	24·1	23·5	70·5	73·0	75·5	77·9	163	59·3	31·9	30·5	29·9	75·6	78·8	81·9	84·9	·494	·558	·620	·684	2·04	1·79	1·615	1·46
3·8	141	414	165	54·0	25·7	24·3	23·6	70·6	73·1	75·6	78·0	165	58·1	32·2	30·8	30·0	75·6	78·9	82·0	85·0	·461	·532	·592	·642	2·14	1·895	1·68	1·49
4·0	143	416	168	53·8	26·0	24·6	23·8	70·6	73·2	75·7	78·1	168	59·0	32·4	31·0	30·2	75·7	79·0	82·0	85·0	·431	·494	·528	·580	2·42	2·11	1·90	1·725
4·5	147	420	172	53·4	26·2	24·8	23·9	70·8	73·4	75·9	78·2	172	58·6	32·6	31·2	30·3	75·8	79·2	82·3	85·2	·344	·431	·474	·524	2·67	2·32	2·11	1·91
5·0	151	424	177	53·1	26·4	25·0	24·1	70·9	73·5	76·0	78·4	177	58·3	32·8	31·4	30·5	75·9	79·3	82·4	85·4	·960	·782	·824	·854	2·93	2·64	2·38	2·085
5·5	155	428	182	52·9	26·7	25·4	24·3	71·0	73·6	76·1	78·6	182	58·0	33·1	31·8	30·8	76·1	79·3	82·5	85·5	·342	·384	·437	·480	2·93	2·64	2·38	2·085
6·0	158	431	186	52·4	27·1	25·7	24·6	71·1	73·7	76·4	78·8	186	57·7	33·6	32·2	31·0	76·2	79·6	82·6	85·8	·315	·360	·401	·441	3·16	2·78	2·50	2·27
6·5	161	434	190	52·1	27·6	26·1	24·8	71·2	73·8	76·5	78·9	190	57·5	34·0	32·5	31·2	76·3	79·6	82·8	86·0	·292	·336	·370	·407	3·41	2·98	2·70	2·45
7·0	164	437	193	51·8	28·1	26·4	25·0	71·3	74·1	76·8	79·2	193	57·2	34·5	32·8	31·4	76·4	79·9	83·2	86·2	·273	·312	·345	·380	3·66	3·20	2·89	2·63
7·5	167	440	197	51·5	28·5	26·8	25·3	71·3	74·2	76·9	79·3	197	57·0	35·0	33·2	31·7	76·6	80·0	83·3	86·4	·255	·292	·323	·354	3·90	3·43	3·10	2·83
8·0	169	442	199	51·4	29·0	27·1	25·5	71·5	74·3	76·9	79·4	199	56·7	35·4	33·6	31·9	76·7	80·1	83·4	86·5	·240	·273	·303	·33[illegible]	4·14	3·64	3·30	3·02
8·5	171	444	202	51·2	29·4	27·4	25·8	71·6	74·4	77·0	79·4	202	56·4	35·8	33·9	32·2	76·8	80·2	83·5	86·6	·225	·256	·285	·314	4·38	3·87	3·48	3·18
9·0	174	447	205	50·9	29·8	27·8	26·0	71·6	74·5	77·1	79·4	205	56·4	35·9	33·9	32·2	76·9	80·3	83·6	86·7	·212	·241	·269	·296	4·63	4·10	3·71	3·38
9·5	176	449	208	50·7	30·1	28·1	26·1	71·7	74·5	77·1	79·5	208	56·1	36·3	34·3	32·4	77·0	80·4	83·7	86·8	·200	·228	·254	·280	4·89	4·33	3·92	3·58
10·0	179	452	211	50·6	30·4	28·2	26·2	71·8	74·6	77·2	79·6	211	56·0	36·3	34·5	32·6	77·1	80·4	83·7	86·9	·189	·216	·240	·265	5·15	4·56	4·13	3·75
11·0	183	456	216	50·1	30·6	28·2	26·2	71·8	74·8	77·3	79·6	216	55·6	36·8	34·6	32·6	77·3	80·7	83·9	87·0	·169	·192	·214	·236	5·62	5·00	4·51	4·12
12·0	187	460	221	49·8	30·9	28·5	26·4	71·9	74·9	77·4	79·7	221	55·2	37·3	35·0	32·8	77·4	80·8	84·0	87·1	·153	·174	·194	·214	6·03	5·40	4·93	4·48
13·0	191	464	226	49·5	31·3	28·9	26·8	72·0	75·2	77·8	80·1	226	54·9	37·7	35·3	33·2	77·5	81·2	84·3	87·3	·142	·158	·176	·195	6·53	5·90	5·33	4·76
14·0	194	467	229	49·1	31·8	29·3	27·1	72·1	75·3	77·8	80·2	229	54·6	38·2	35·6	33·6	77·6	81·4	84·5	87·5	·133	·147	·165	·179	7·01	6·39	5·72	5·23
15·0	197	470	233	48·9	32·5	29·7	27·6	72·1	75·4	78·0	80·2	233	54·3	38·4	36·1	33·9	77·7	81·5	84·5	87·6	·125	·137	·152	·167	7·48	6·80	6·14	5·58
16·0	200	473	238	48·6	32·7	30·2	27·7	72·2	75·6	78·0	80·3	238	54·1	38·7	36·6	34·1	77·8	81·6	84·6	87·7	·118	·129	·143	·157	7·94	7·29	6·58	5·98
17·0	203	476	241	48·3	33·2	30·6	28·1	72·4	75·7	78·2	80·4	241	53·9	39·0	36·7	34·5	77·9	81·7	84·7	87·8	·112	·122	·135	·148	8·46	7·70	7·00	6·46
18·0	206	479	245	48·0	33·4	31·1	28·5	72·5	75·9	78·3	80·5	245	53·6	40·1	34·5	35·0	77·9	81·8	84·8	87·9	·106	·116	·128	·140	8·96	8·20	7·41	6·76

F. T. S. Sept. 18 1905

TABLE VII.—THE PROPERTIES OF STEAM IN ELECTRICAL UNITS.

rating station in per cent., then the fuel cost in pence per KW.-hour of annual output from generating station

$$= \frac{1{,}200 \times \text{cost of coal}}{\text{calorific value} \times \text{efficiency}}.$$

Thus, in the case of the Sheffield Corporation Tramways, we have: Fuel cost in pence per KW.-hour of annual output from the generating station

$$= \frac{1{,}200 \times 8{\cdot}2}{7{,}700 \times 6{\cdot}1} = 0{\cdot}21.$$

The writer believes that the tables and examples which he has set forth afford a good illustration of the advantages which would accrue as the result of the general use of electrical engineering nomenclature. Far more complete tables should be prepared and published in engineering handbooks.

As a beginning the writer puts forward the following table (No. VII.) for the properties of steam, and trusts that others will gradually add to the collection a set of consistent tables relating to those aspects of steam and electrical engineering on which they chance to be engaged.

PROCEEDINGS OF INSTITUTIONS.

Motor-Car Services in Relation to Tramways.

By NORMAN D. MACDONALD (Member).

(*Abstract of Paper read before the* TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION, *March 27th*, 1906.

LET me say that I have no interest whatever in any company or concern which builds autocars or motor-omnibuses. I plead guilty to starting the first public service of autocars of any size, and for a city. Seven years ago, in my native city of Edinburgh, I pioneered with a fleet of cars. We failed, and lost £14,000 (the cars cost £330 to £400), but not because the principle was wrong, but for other reasons. Most of these old cars are running still, and every day, on the streets of Edinburgh, which speaks volumes to those who can think of the capabilities of really modern, good petrol vehicles. My new company is starting in Edinburgh with 30 large motor-omnibuses at once, and by autumn we hope to have 50 running, and within a year 80 to 100. I also pioneered in London more than two years ago with an Edinburgh friend, starting to run the first continuous real motor-omnibus service, which has now grown to a big company, which will shortly have 80 'buses for its second stage, and perhaps within a year double that number, for we have built the largest garage in the world, capable of holding about 160 motor-omnibuses.

But I am not an enemy of tramways by any means. Tramways have done, are doing, and will continue to do great public service—filling a great public necessity—for what we all need is rapid and cheap transportation. It will be necessary in order to get down to facts and to the truth, to dissect the relative positions and prospects of tramways and autocar services.

To pass for a moment to light railways, I think any extensions of these will now be few and far between, for the road is the proper place for their class of traffic; and with mechanical power road vehicles, the general advantages are overwhelmingly against light railways. To give an instance, the N.E.R. abandoned a very good scheme for a light railway from Beverley to Beeford, 14 miles, which would have cost over £40,000, and taken two or three years to get running, in favour of autocars costing a few thousands, put on at once, and giving a service which no light railway could ever give.

So far as street traffic is concerned, I ventured to prophesy five years ago that we were on the eve of two great changes—and now they are at the very door: (1) All street traffic will move at a much greater pace. (2) A vast improvement in street surfaces.

The paramount necessity for flat smooth streets will make the public mind grasp more and more the inconvenience and danger of rails, with their ruts and grooves—especially for india-rubber tires and for fast travelling vehicles. Most unfortunately tramways tend by their very nature to monopolise the important part of the road, the crown of the causeway; also for economical working the vehicles must be of great size. This mere size again entails more frequent and longer stops. Hence they tend largely to prevent *the* thing which not only allows of rapid transit, but also relieves street congestion; namely, that the faster vehicles shall be able to pass the slower. Tramcars *must* do all their stoppages for passengers or terminal work on the most important part of the street.

When the traffic of the tramway itself reaches a certain point it defeats itself, because you are compelled to try to work it all (in either direction) on 4 ft. 8½ in. Hence you get a string of cars checking each other, by their constant stops for passengers.* I will not dwell on the troubles of blockades by miles of cars pinned to their tracks in the case of breakdowns, accidents on the line, fires, tumults or processions.

Whatever speed is possible and proper for trams, then something higher is possible or proper for motor-'buses.

The main propositions as to safety depend on (1) manœuvring possibilities; and (2) stopping powers. The tram cannot manœuvre, and hence has no capability of this sort—either to avoid, or to assist in avoiding, an accident.

India-rubber tires on road surfaces also give a high braking efficiency. I note also, in passing, the important factor of what is called "collision energy"; it is manifest that the length of the stop, and the possibilities for evil should an impact occur before the end of the stop, are more serious where the collision energy is stored up in the mass of one sort of vehicle which weighs about three times that of another type.

Lastly, let us note the dangerous whirlings and loss of steering power of motor-omnibuses, commonly called "side slip"; with modern heavy, long-wheel based, twin-tired vehicles side-slip is rare, and only when you have really *greasy* mud.

The matters touched on above should make us pay heed to the new ways and see how we can work them into our own service and advantage. One obvious plan is to use auto-vehicles as feeders, either to get an immediate service and traffic, or a cheap service, or a service flexible as to volume of traffic, direction of traffic, rush-hours, street blockades and so on, having in view chiefly the object of developing traffic, or diverting traffic from rivals, on to the heavily capitalised tramlines. As roughly 20 *per cent.* of motor-omnibuses should spend a good part of each day in being tuned up, a clever traffic manager can utilise his whole fleet in a suburban district of a town not only by having an extra service at the rush-hours on his all-day "feeder" routes, but by sending other omnibuses into suburban parts at the rush-hours. Thus we have regular "feeders," and irregular "feeders" which can scour the whole district to round up those to whom time is paramount, and to distribute them again at night as near their doors as possible.

But let us go further afield and, remembering the limitations of tramways as to speed and capacity, remark that a coadjutor fleet of motor-omnibuses can be used to do overlap work. Bearing in mind that speed of service is more important to those further out, it would seem well to consider the advantages of running your own motor-omnibuses alongside your cars, but starting from termini beyond the tramlines. Thus a 'bus which has filled up can itself make an express service into the centre of the town. Or, in any case, you can have an express service alongside the trams for the long-distance passengers—leaving the more local work to the slower and more cumbersome vehicle. The 'bus stopping places might be at longer intervals. It is better surely to have your own friendly service, bringing all the grist to one mill, overlapping or paralleling your cars, than to have lively competitors working the same road. I venture to say that once they have enough 'buses for the internal parts (in big cities like London) the 'bus companies will invade the surrounding tramway territories and filch the through traffic with ease. In other towns where the streets are fairly wide and the traffic not very dense motor-omnibuses will be very serious rivals to trams. It is certainly much easier to hold traffic than to regain it. Moreover, the simple British public will stick to, and support, any organisation which it feels is trying to progress and to give it a good service, run by brains. "Move with the times," is the safe course.

There are certain days—such as Saturday afternoons, Sundays and holidays—which are the despair of a tramway manager.

Here the auxiliary fleet of cruising omnibuses would come in, not only as proper auxiliaries alongside the tramlines on the routes of main movement, but as available to be sent wherever the holiday tide was flowing.

The inflexibility of tramways is a cause of loss to themselves even where they have the luck to terminate near a place of great popular resort, because things like football matches and fireworks only disport themselves at definite hours. Given a fleet of auxiliary omnibuses a good engineer will have them all in fettle on days of public rejoicing, and a good traffic manager will have them plying early to the match or display, and then concentrate them in side roads *en masse* till the "scaling" of the crowd comes, and then will call up his swift reserves. Be it noted also that on such occasions the omnibus service can be made "extra special express" by going and returning by practically deserted side streets.

I have been consulted several times by the General Post Offices, both in London and Edinburgh, as to the possibility of getting the mails taken by autocars on roads, more than they are at present. I have told them their only hope to get it done (at their rates) is by big organisations, and probably by those which exist already, having staff, offices, managers, depôts, and so on; in fact, making the night mails a side show. I throw out the suggestion to the big tramway organisations in populous districts as another way to bring in grist per the new rival, since they have their on-cost charges in any case.

Some tramway systems convey parcels—notably our Edinburgh and District Tramways, whose organisation is good and gives useful service. In such cases an auxiliary service of motor-vans would help, because they could collect and deliver to and from the offices or depôts at the tramway lines termini. The same idea can be expanded to freight proper. In fact, the mobile motor-vehicle may be found a good auxiliary for handmaid work to the fixed tramway.

The main question for us seems to be: "Can the motor-vehicle affect our interests?" If not, then let us stick to business and ignore it. But if we have to say "Yes, it must affect us"—then the question is, "Favourably or unfavourably?" The further question comes, "Shall we make it a rival, or shall we bind it to our chariot of progress as an auxiliary as well as learn from it transportation lessons, so as to know our own weak points?"

Discussion.

The Chairman (Mr. W. Beaumont), in moving a vote of thanks to the author, remarked that in the earlier part of the paper some might have thought he was dealing with the motor-vehicle *versus* the tramway. It became obvious, however, in the latter part of the paper, that he was dealing judiciously with "Tramways plus Motor-Vehicles," or, at all events, "Motor-Vehicles plus Tramways."

Mr. Emile Garcke said that he expected to hear a great deal in opposition to tramways and in favour of motor-omnibuses, but there was much in Mr. Macdonald's Paper with which he cordially concurred. He regarded the motor-omnibus as a means of improving the tramway services. Where they had a tramway system which was well designed, and was serving a densely populous district, he did not think the competition of the motor-omnibus need be feared by tramway undertakers, but where they had an indifferently-designed tramway—a tramway which studiously avoided connecting two populous centres—the motor-omnibus had an excellent field for providing that service which, were it not for the jealousy of local authorities, or the incompatibility of temper between the local authority and the company, would enable the public to enjoy the full benefit of electrical tramways. If the writer had as much experience of the actual operation of tramways as he had enthusiasm for improved methods for providing facilities, he would recognise that many of the suggestions which he made would prove to be very difficult to carry out. He spoke of the congestion which tramways tended to cause, but motor-cars would experience exactly the same difficulty of penetrating the traffic. He could refer him to several cases where electric tramways had tended to relieve congestion. The writer's references to light railways were very interesting and important, as pointing to the harm that was frequently done by paternal legislators who killed an industry by kindness. The light railway industry in this country had been almost entirely misunderstood, and the future development of light railways was likely to be very small. It was a very regrettable thing, because on the Continent light railways had served a very useful purpose, and there was no reason whatever, if light railways had been authorised on the same economical lines as in Belgium and other parts of Europe, why they should not have had very extensive systems of light railways serving agricultural districts. Now that the motor-omnibus was tending to be satisfactorily developed, it was probable that these services could be equally afforded by means of motor-omnibuses. But the motor-omnibus had a great deal to accomplish before it could be considered perfect, and in making comparisons between the merits of the motor-omnibus and the electrical tramway, they must not forget the enormous economy in working electric tramways. The ability to generate the power at one centre and distribute it all over the line was so great as compared with the working of individual vehicles carrying their own power that electrical tramways in densely populated districts, where a frequent service was possible, were certain to hold their own against motor-omnibuses. The advantages of cheap power were sufficient to justify

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* Great Britain is practically the only country where double-deckers are common; because speed has not been much considered.

the laying down of rails at a cost of perhaps £6,000 per mile, single track, and the cost of depreciation, interest and sinking fund for permanent way, was only equal to about the cost of the rubber tires of the motor-omnibuses. He had been concerned in operating a fleet of motor-omnibuses in a provincial city, and the costs of operating were practically double the cost of working an electrical tramway system. The motor-omnibus might be considered to have an excellent field where electrical tramways were not practicable—where the streets were too narrow, or where the traffic was not thick enough to justify the expenditure necessary for the permanent-way. But he was inclined to think that if the outskirts of a big tramway system did not justify tramway extension there would not be sufficient to justify a satisfactory service for motor-omnibuses. Overlapping the tramway termini was not a very satisfactory system, either for the tramway or the motor-omnibus undertaking. The number of vehicles they would have to provide for the purpose of dealing with rush traffic would be such as not to justify the capital outlay for the occasional use. Another point to be remembered in connection with motor-cars was the very large proportion of reserves necessary to maintain a regular service. As one who had been responsible for the investment of very considerable sums of money in tramways, and thus speaking with a due sense of responsibility, he regarded the motor-omnibus as a desirable adjunct, and as a competitor which was likely to render good service, not merely to the public, but to tramway undertakers. His company was engaged in putting up a factory in this country for the manufacture of motor-omnibuses, and also for operating several systems of motor-omnibuses in various parts of the country.

In reply to Mr. Macdonald, Mr. Garcke added that the working costs were 5d. and 6d. a car-mile for tramways as compared with 10d., 11d. and 1s. per car-mile for motor-omnibuses.

Mr. Shrapnell Smith said that it was full early to talk with any real confidence about motor-omnibus costs, for several reasons. It might perhaps be of benefit to look to the early days of the tramways, and see what reduction had been effected in the cost of working them. No doubt the motor-omnibus costs would fall. One considerable factor in the large cost and in the large proportion of vehicles laid up was the difficulty of getting spare parts. There were services in London that day where perhaps 30 *per cent.* of the vehicles were not being run because of the want of spare parts, whilst new complete chassis had to be stripped, and that cut a very bad figure in the revenue account. Then there was the question of the cost of power, and the advantage of deriving power from a central generating station; it was an open secret that motor-omnibuses were being experimented with, and might shortly be on the road, where the explosive mixture would be derived from a producer plant in the vehicle, which would give the unit just as cheaply as they could get power from a central generating station. Of course any development of that kind unquestionably wanted a considerable amount of working up. When the single-deck steam vehicles were tried in London they were condemned, but the fact that the people who condemned them had now clos on one hundred on order, was testimony to the rapid changes which occurred, and the changes of opinion that might be rightly brought about by the improvements in the boilers and so on. As to the question of obstruction caused by a bigger or smaller vehicle, Mr. Macdonald pointed out that if the tramway cars were not so big they would obstruct themselves, because if they were smaller more of them would be required. There was, on the other hand, the argument that the smaller the unit the fewer stops each would have to make to take the people up and put them down. In many cases these arguments balanced, although not always. The great difficulty in the present day was in getting drivers for these motor-omnibuses; two shifts were necessary, unless they wanted a strike, and that meant that a large number of trained men had to be brought into a state of efficiency very rapidly. They had to get many new drivers, and a great number of the skids which made themselves evident on wet days were due to the men, who would jerk the steering wheel about. The Bath Co. had been enabled to use motor-omnibuses with safety on Lansdown Hill, and he thought in many cases where tramways existed, motor-omnibuses could be brought in to serve as feeders in any district where, perhaps, it was not safe to lay tramways.

The Rev. W. J. Scott referred to the remark that motor-omnibuses might be run where the roads were too narrow for tramways; if Brentford High Street were a road wide enough for a tramway, one would have to search far enough to find a place which was not wide enough. The London United Tramways had pushed along their system to Hounslow and Isleworth and Twickenham, to Richmond and to Hampton Court. On Bank Holidays and other holidays the cars were crowded, but at other times, sometimes, he was the only passenger on a car. There were fairly populous towns and suburban villages that they ran through, but under ordinary circumstances there was not enough traffic to support tramways. It was expensive for many motor-omnibuses to stand idle, but that would be more economical than for a tramway to stand idle. The motor-'bus services from Penzance to Land's End ran frequent trips with heavily-loaded cars, and these certainly made at times 20 miles an hour downhill; with one particular driver he had known the vehicle in places to make distinct jumps, when for 2 or 3 yards the wheels must have been off the ground. But they had never crushed a single cyclist, and he had never known the slightest case of side slip. That was due entirely to good driving.

Sir John Macdonald said that a light railway was a line on which no one had the right to go without leave of the company. A tramway was a public road on which the company had a right to go, and which it might use exactly as it liked on two lines of rail, and the rest of the public must take what use it could get of its own highway.

Mr. Henry Ruffer asked how much Mr. Macdonald allowed for depreciation of tramways as compared with motor-cars? His own undertaking generally allowed about 15 per cent. in the year for depreciation. He thought motor-'buses would pay very well for the first five years; but the moment they allowed a fair depreciation, which could not be very much less than 30 per cent., it would be quite another matter. Tramway men need not be very much afraid of motor-omnibus people, provided the latter allowed enough for depreciation.

Mr. Percy W. Northey said that a very serious difficulty had arisen as to whether the local authorities should allow powers for tramways, and also as to whether it was worth while competing with 'buses. He did not think that at that time anyone there knew the cost of working motor-omnibuses except for a few months, which could in no way be taken as the cost of working omnibuses during the next few years.

Mr. H. Conradi said the tramways in the United Kingdom covered something like 1,483 miles, carrying about 1,394,453,000 passengers per annum. The horse-omnibuses were about 1,400 in number, and the passengers carried per annum by the omnibuses were 209,462,000. Taking the number of tramcars to be about 8,000, and the number of horse-cars at 1,400, they would require something like 40,000 small or 20,000 large motor-omnibuses to replace them. Motor-omnibuses produced very unpleasant and unhealthy smells in the streets from the *un*refined petroleum used, also very heavy dust-waves, and considerable noise from the gearing and the wheels. He did not see, as a tramway engineer, that motor-omnibuses, however perfect, would in years to come be able to replace the tramway service.

The Chairman said that, not because of the danger, with motor-omnibuses they must think not only of the difficulties of conducting traffic when they got more and more motor-omnibuses, but of the impossibility of keeping the wear and tear down to what it ought to be kept down, so long as they had to run these 'buses at good speeds on roads and streets with the surfaces which they had at present. Roads were made, and then left to get into a very bad condition. So long as that was so, and even when they were all made as good as the best were now, the high speeds that many people were prophesying must be destructive to the motor-omnibus and its machinery. That being so, in many cases 25 per cent. depreciation would have to be allowed, and in the best cases they would have to adhere to 20 per cent. depreciation, which was the amount generally adopted. It was not the high maximum speed they wanted, but the high average speed.

Mr. Macdonald, in his reply, said that he was not trying to compare motor-omnibuses with tramways at all. He tried to open the tramway mind to the main fact that all street traffic in the future would move at a much greater pace. Hence the public would put up its back more and more against those tramway blocks, which were the greatest obstacles to the fast movement of every other kind of vehicle. He had not suggested the replacing of tramways by motor-omnibuses, but that tramway companies ought to take up the motor-omnibus to assist them, instead of spending money to put down more tramways. Personally, he thought that a motor-'bus service could compete well with tramways on the same street, unless it was so narrow that the trams blocked too much. He thought Mr. Conradi's figures as to the number of horse-omnibuses were wrong; there were over 3,000 in London alone. The cost of working motor-omnibuses was more likely to go down than up. The cost of working in London, from his own experience, ought to be about 7d. per mile for motor-omnibuses, but it might be more. The costs of running motor-'buses with good management and good vehicles were generally much overstated.

Institution of Electrical Engineers.

The following nominations for election of Council and hon. officers for 1906-7 were announced at the ordinary general meeting on Thursday, April 26th:—

As President: *Dr. R. T. Glazebrook, F.R.S.

As Vice-Presidents.

*Mr. F. Gill. — Mr. W. H. Patchell.
Mr. W. M. Mordey. — *Mr. C. P. Sparks.

As Members of Council.

Mr. W. A. Chamen. — Mr. Walter Judd.
Mr. W. Duddell. — Mr. Gisbert Kapp.
*Mr. S. Evershed. — *Mr. J. E. Kingsbury.
*Mr. H. E. Harrison. — Mr. C. H. Merz.
Mr. J. S. Highfield. — *Mr. M. O'Gorman.
Mr. H. Hirst. — *Mr. G. W. Partridge.
Col. H. C. L. Holden, R.A., F.R.S. — *Mr. A. A. C. Swinton.
Mr. C. H. Wordingham.

As Associate Members of Council.

Mr. Albert Campbell. — Mr. T. Mather, F.R.S.
*Mr. J. Hunter Gray.

As Hon. Auditors.

Mr. F. C. Danvers. — Mr. Sidney Sharp.

As Hon. Treasurer: Mr. Robert Hammond.

The names marked with a star are those of gentlemen nominated to fill vacancies in the Council in accordance with Article 45 of the articles of association. All the honorary officers, being eligible, are nominated for re-election.

At the same meeting it was unanimously resolved to forward a vote of condolence on the part of the Institution to Mme. Curie on the untimely death of her husband.

The Faraday Society.

Some Recent Developments in Electric Steel Smelting.

Now that the promising results obtained by M. Héroult and Dr. Haanel, on behalf of the Canadian Government, in their preliminary experiments on the electrical production of pig-iron, have again attracted public attention to this branch of electro-metallurgy, it was in keeping with the fitness of things that the April meeting of the Faraday Society, held on the 10th ult., should have been devoted to the discussion of the present position of some of the kindred processes—those of Stassano, Keller, and Gin now being rapidly developed by other metallurgists for the manufacture of iron and steel in the electric furnace in other parts of the world. Some brief reference to the Canadian experiments, by way of introduction will, perhaps, not be out of place here. The experiments, which were made in February at Sault Ste. Marie on the works of the Lake Superior Power Co., are claimed to have proved two things; first, that Canadian magnetite of high sulphur content, which is the chief local ore, can be economically smelted electrothermically into a pig-iron containing inappreciable quantities of sulphur, and with a varying silicon content; and secondly, that charcoal and peat coke, which can be produced cheaply and in abundance in Ontario and Quebec, can be substituted for coke without being briquetted with the ore. Of course, it must not be forgotten that these results are really *experimental;* the plant used was one of only 300 E.H.P. capacity, and the total production (up to March 5th) was but 55 tons; but they at least form a sound and promising basis for future developments, developments that will be keenly awaited and carefully watched by all who are interested either in the future of Canada or in the future of electric smelting.

To return to the Faraday meeting, M. Keller's paper, which, like those of MM. Gin and Stassano, was communicated by Mr. F. W. Harbord, dealt with the new results obtained by him in 1905, since the publication of the Canadian report. Progress has been of two kinds, industrial and experimental. The former consists in the erection by Messrs. J. Hoetzer & Co., at their works at Unieux (Loire), of a 1,500-H.P. electrical steel plant, the product of which will be used for the manufacture of cannon and projectiles. Current is provided by a 20,000-ampere Westinghouse alternator driven by a Dujardin steam engine. The furnace, which rests on a steel cradle, is a tilting one, of 80 tons capacity, and it weighs about 500 tons; the various mechanical and electrical controls are obtained by hydraulic motors. The electric current will be used exclusively as a de-oxidising, refining and heating agent, the steel obtained in a Siemens-Martin furnace being run into the electric furnace immediately after the oxidising melt, and the operations there completed. The output of the plant is expected to be about 250 to 300 tons per 24 hours. The author, at present writing under some reserve, promises at a future date to furnish details of the results obtained at Unieux.

The second portion of M. Keller's paper describes experiments that he has recently made at Livet in a 1,000-H.P. furnace on ores of various compositions for the purpose of comparing the metal obtained by the electric furnace with that obtained by the blast furnace from the same ore, and he shows curves giving the proportions of carbon and silicon in the two cases. It appears that the Keller furnace allows of ready desulphurisation and of easier variation in the carbon and silicon contents than does the blast furnace. It is interesting to note in this connection that, so long ago as 1882, Sir William Siemens and Prof. Huntington read before the British Association a paper describing some experiments that had been made to determine the maximum amount of carbon that pig-iron was capable of taking up in the presence of a given quantity of silicon. These experiments were made by Prof. Huntington in the famous Siemens electric furnace, with a current of some 250 to 300 amperes, and they proved that pig containing from ½ to 9 per cent. of silicon could easily be obtained. In the ordinary way silicon content is varied without difficulty by adding high or low silicon pig to a cast, as the case may be, but Mr. Harbord pointed out that it might, under special circumstances, be useful to obtain a highly silicious product in the way described by M. Keller—namely, by increasing the carbon in the melting bed and raising the temperature, which, of course, in the electric furnace is very readily brought about. Some tests made at St. Chamond by M. Chavannes showed that the excellent grey castings yielded by the Keller furnace were soft, very homogeneous and close grained, that they could be easily cut without tearing, took a fine polish in grinding, and gave satisfactory results on being subjected to the usual tensile tests. M. Keller has recently erected a 2,000-H.P. furnace at Livet, utilising a current of 25,000 amperes, and capable of producing 20 tons of iron in 24 hours. This will be used exclusively for the direct reduction of ore. The Livet plant has now a total capacity of 13,000 KW., and its output is 35 tons a day of the various ferro-alloys.

M. Stassano's paper describes the 140-KW. arc furnace (one of three ultimately to be erected), which the Firni Termoelettrici Stassano Co. has installed at the Artillery Construction Works, Turin, for the purpose of refining pig-iron and scrap, and so making steel suitable for artillery projectiles. The furnace is designed to yield about 24 tons of steel in the 24 hours, and the product contains 0·3 to 0·4 per cent. carbon, 1·2 to 1·5 per cent. manganese, and 0·03 to 0·04 per cent. phosphorus. The furnace is a rotating one, revolving once or twice a minute, and it was this feature especially which came in for some criticism at the meeting, many of the speakers, including Mr. Harbord himself, Mr. Murray Morrison and Prof. Huntington, considering it the weak point of the Stassano model.

M. Gin's furnace, the latest types of which were likewise explained to the Society at the last meeting, has not yet reached beyond the experimental stage, so judgment concerning it must be suspended for the present. In the original type, it will be remembered that carbon electrodes were dispensed with, and large water-cooled iron block terminals were used instead, leading the current into a long basic-lined channel or canal, bent round on itself like an incandescent lamp filament, which formed the furnace hearth. Wisely profiting by criticism, M. Gin has lately been trying to revert to carbon terminals, and the essential feature of his furnace has been so far modified that the canals are now used simply for heating, the refining taking place in separate chambers. Whether the furnace, as at present conceived, offers any special advantages over, say, the Héroult or Keller form, is a point concerning which the inventor has not yet succeeded in convincing steel experts, and which must, therefore, for the present, until M. Gin's experiments have advanced nearer to the commercial stage, be considered as *sub judice*. The author's investigations are being carried out at Plettenberg, in Westphalia.

The Cleaning of Work by Means of the Electric Current.

Mr. H. S. Coleman presented a short practical paper on this subject. The work to be cleaned (usually preparatory to electroplating) is suspended in a hot solution of equal quantities of brown Montreal potash and sodium hydrate contained in a wrought-iron tank. The work and the tank are connected to a dynamo, and the tank used as the anode for five to ten minutes, the voltage being about 2·5. The current is then reversed for a short time, until the surface of the work is clear and bright. The operation is repeated as many times as may be necessary. The process causes the grease, consisting chiefly of tallow, to become saponified and to go into solution. The lighter dirt is thrown upon the surface of the bath, and may be skimmed off; the remainder falls to the bottom. In conclusion, the author points out the economies effected by the process as against hand scouring.

SWITCHES OPERATED AT A DISTANCE WITHOUT SEPARATE WIRES.

There are many purposes, such as the switching on and off of certain lighting circuits, the disconnection of transformers at times of light load, so as to avoid the open-circuit losses, the changing of the gear in double-tariff meters, &c., for which a cheap and reliable switch, arranged for operation at a distance, is a desideratum. Many arrangements with this object have been devised, but none of them has obtained any widespread application, chiefly because of the expense and trouble involved in running the additional lines required for their operation.

In a recent number of the *Elektrotechnische Zeitschrift*, Herr W. Multhauf describes some novel arrangements for which no special wires are required, and which are operated by means of slight changes of the working frequency in the case of A.C. supply, or by the superposition of a small alternating or pulsating current on the ordinary working current in the case of a D.C. supply.

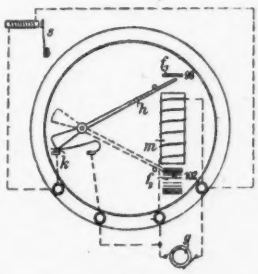

Fig. 1.

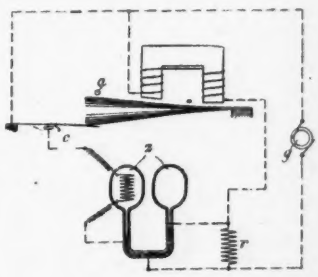

Fig. 2.

The essential part of such an apparatus is a resonance relay to act as receiver and to actuate the switch either directly or indirectly. This relay consists of one or more steel tongues tuned to respond to certain definite frequencies. When the required frequency is reached, either in the alternating current or in the pulsating direct current, the corresponding tongue is set into violent vibration with an amplitude of 20 mm. or so, and this vibration, either by actual mechanical impact or by closing a local circuit, causes the required switching operation to be carried out.

One suitable arrangement of the resonance relay is shown in fig. 1. It consists of an alternating magnet, m, with two steel tongues seen end on at f_1 and f_2. Suppose the normal frequency of the supply is 50 cycles (100 alternations) per second, and that the maximum unintentional variation from this frequency is 1½ per cent. Then one of the springs (f_1) would be tuned for 98 alternations and the other (f_2) for 102 alternations. If now the supply frequency is deliberately raised to 102, f_2 will be set in vibration, and will cause the lever h (which is balanced so as to be in unstable equilibrium in all positions except at the two end points of its swing) to be thrown up into the full line stable position, where it serves to close a local circuit at the contact k. This position will be retained by the lever until the frequency falls to 98. At this

lower frequency the tongue f_1 is set vibrating, and throws the lever back into its original (dotted) position, opening the local circuit. In some cases the additional local circuit may be omitted, and the lever can be made to produce the required change directly.

When such relays are to be used for various purposes on one and the same supply, *e.g.*, one set of relays for switching out transformers, another set for changing the gear of double-tariff meters, &c., a definite frequency must be decided on for each purpose, and steps must be taken to prevent relays from working at any but their own particular frequency.

The arrangement shown in fig. 2 is suitable for this case. The lever (corresponding to *h* in fig. 1), which operates the switch, is not shown, but its position of rest is indicated at *a*. This position of rest is just outside the normal amplitude of the swinging tongue. The tongue, however, acts on an auxiliary contact *c*, which it closes practically continuously when resonance between the supply frequency and the tongue exists. The closing of *c* causes a current to flow through an auxiliary apparatus, such as the mercury contact device *z*, which does not act instantaneously, but only after a definite time interval. This apparatus, *z*, is used either to increase the amplitude of the swinging tongue by short-circuiting the resistance *r*, or to bring the point *a* closer to the swinging tongue. In either case the main lever at *a* is operated after a definite time has elapsed from the instant when the tongue commenced to vibrate resonantly. In some cases the arrangement *z* can be used to carry out the required switching operation directly without the interposition of the main lever *a*.

In this way the frequency corresponding to a particular relay can be passed without operating that relay, provided the change of frequency is not carried out too slowly, and relays with frequencies on either side of the frequency of this particular relay can be operated.

Although the vibrating tongues can be tuned so that the amplitude of vibration changes from practically zero to its maximum value with a change of only ½ per cent. in the frequency, such small changes are not usually advisable in practice, because the unintentional and unavoidable variations are often greater than this.

The writer mentions that at Frankfort variations of 2 per cent. occur, whilst at Kiev, with 2,000-H.P. triple-expansion Tosi Legnano engines, coupled to three-phase and direct-current generators for traction purposes, variations of 2·5 per cent. have occurred. As regards the permissible intentional alterations of frequency, the above Kiev machines, working in parallel with other generators of 500 and 200 H.P., and with a synchronous motor of 150 KW., allowed variations between 97 and 102 alternations to be readily obtained, even though these variations were not carried out from the switchboard.

On these two points (1) the maximum unavoidable variation, and (2) the maximum permissible intentional variation, the question of the satisfactory working of these relays depends, and with a view to encouraging experiment in this direction, Messrs. Hartmann & Braun, the holders of the patents, are prepared to loan the necessary apparatus to station engineers.

KINGSLAND SURFACE CONTACT DEVELOPMENTS.

As recently as our issue of November 10th, 1905, we had occasion to discuss the relative advantages and failings of the more promising surface contact systems before us at the present time. Among these, the Kingsland system attracted some attention, as though it involved an extra slot or shallow conduit of about rail depth in connection with the track, for the mechanical operation of the switches which energise the road studs, yet it dispensed entirely with heavy electromagnetic collecting equipments, and, what amounts to far more in actual working, avoided the continual extra energy consumption due to the use of this apparatus. However, although the idea seemed an excellent one, we expressed the opinion that the average tramway manager might justifiably doubt the effectiveness of certain constructive details employed in its carrying out; an opinion which we believe to have been amply justified in the light of the important constructive modifications which the Traction Corporation has recently introduced into its system.

As our readers are doubtless aware, the subject of tramway extension has recently been to the fore in the Scottish capital, where the practical limitations of the cable system appear to have made themselves felt.

However, much siller having been sunk in the construction of a conduit for the cable tramway, the guid folk of Edinburgh are faced with a natural disinclination to do anything so drastic or uncanny as the scrapping of their conduit, even with the larger object in view of adopting some system of traction more suitable for the extended scheme.

Under these circumstances the recent offers of the Kingsland Syndicate to utilise the existing centre slot for their surface contact system in such a way that the present cable cars can run over the same track without interference, assume considerable importance and will probably receive much support locally. To use the centre slot and provide for the passing of cable grippers, of course, necessitated some modification of the original Kingsland construction, and Mr. Robert Brown, the managing director, has embraced the opportunity practically to redesign the details of the system. The new designs, which present a welcome simplicity of detail compared with the old, and a corresponding decrease in first cost, include a strongly made switch, of apparently watertight construction, which closes the stud circuit by a rotation of approximately 90° in either direction. The switch is normally held in the off position by a powerful helical spring; the lever for operating the switch projects into the conduit slot and a flexible operating bar, 14 to 21 ft. in length, suspended from the underside of the car and dipping some 6 in. into the slot, brushes aside the switch lever during the passage of the car, switching on and energising the stud during that period. Obviously, the passage of the gripper of a cable-car along the slot, will also switch on the stud momentarily, but as the stud will be under the car at the time, no trouble is anticipated from this. As far as the switch box is concerned, a casual inspection reveals its superiority to the original design; the substitution for the somewhat toylike 3-brush fingered switch, of a heavy two-armed switch of much superior current-carrying capacity being a much-needed improvement which will go far towards meeting the occasionally strenuous conditions of tramway working, in cases of short-circuit and the like. Then in regard to the service cables, special attention has been given to making these watertight at their points of entry into manholes, and the short connecting cables between the service terminals and switch box, and between the latter and stud, are conveniently arranged for plugging into sockets at their ends distant from the box, while they enter the latter through suitable glands.

While the time is not opportune for fully describing what are undoubtedly far-reaching improvements, the facts that the new gear has been tested to the company's satisfaction at speeds up to 22 miles per hour, that a sample switch has withstood with ease some 700,000 operating blows, which represent practically seven years' normal work, and that the company has backed its fancy to the extent of offering to equip one of the most awkward and costliest to work of the present cable routes into Edinburgh, and to remove the apparatus if not satisfactory, with an additional proviso that the energy consumption shall not exceed what might be expected with an overhead trolley system, are indications of the progress achieved with the new designs.

We believe the company's offer in the case of the Edinburgh tramways is to insert the switch box, contact stud, &c., at 18-ft. intervals, using the existing centre slot, also to lay all service cables up to the Corporation section boxes, for £2,500 per mile of single track, a price which may or may not represent an ultimate saving of bawbees, but will certainly enable the Corporation to save both its conduit and its face. Much might be hazarded in regard to the future behaviour of the lengthy operating bar which has supplanted the fore and aft strikers of the original arrangement, but presumably it will be a fair exchange for the plough as far as Edinburgh is concerned, and at any rate will enable one of the lightest of electrical car equipments to be adopted, an obvious advantage where overrunning and duplicate equipments have to be considered.

We understand that the modified Kingsland system, which we hope to describe in a future issue, has been adopted for one and is being considered for another Indian city; under the peculiar circumstances obtaining at Edinburgh, its adoption there would at least be appropriate.

Roller Bearings.—Amongst the recent contracts booked by the Empire Roller Bearings Co., Ltd., are the fitting of 60 additional heavy goods wagons with roller bearing axle-boxes, making 140 wagons thus fitted for one company, and 100 tramcar axle-boxes for Peckham trucks for Brazil. The company has also entered into several large contracts for heavy shafting and machinery for ginning factories in India and several factories in England.

THE MURRAY AUTOMATIC PRINTING TELEGRAPH SYSTEM.

The Murray automatic page-printing telegraph system, described and illustrated in our issues of March 13th, 20th and 27th, and April 3rd, 1903, and further dealt with in our issue of March 24th, 1905, has now been installed between St. Petersburg and Moscow. The inventor, Mr. Donald Murray, who has recently returned from Russia, states that some remarkably successful trials of his system have been carried out on long Russian telegraph lines.

On February 23rd, 1906, a telegraphic loop line was made up as follows:—St. Petersburg-Moscow-Smolensk-Vitebsk-St. Petersburg. The loop was triangular in shape, and the length of the line was 1,106 miles (1,770 kilometres). The wire was 5 mm. iron (about 600 lb., 8·88 ohms per mile), and there were two Wheatstone repeating stations, one at Moscow and one at Vitebsk. The Wheatstone automatic system (using the Morse alphabet) got 55 words per minute perfectly, but failed at 60 words per minute. The Murray system (using the Baudot alphabet), under exactly the same conditions, got 90 words per minute perfectly, but failed at 100 words per minute.

On February 24th, 1906, the following loop was made up:—St. Petersburg-Yaroslavl-Kazan-Moscow-St. Petersburg, a distance of 1,926 miles (3,082 kilometres), 5 mm. iron wire (600 lb. per mile), with repeating stations at Yaroslavl, Kazan and Moscow. The speeds obtained were indefinite, as one of the sections was not in good condition. The Wheatstone got about 35 to 40 words a minute, and at times a little higher. The Murray system got 56 words per minute, and 10 messages were transmitted and printed. They were found to contain two wrong letters, a remarkably good result considering the condition of part of the line. This is the first time on record that a printing telegraph has worked over such a distance as 1,900 miles, even of copper wire, and in this case the wire was iron.

On February 25th, 1906, a trial was made of a loop without a repeater from St. Petersburg to Moscow and back, 800 miles (1,280 kilometres) 5 mm. iron wire, about 7,100 ohms in the line and 800 ohms in the receiving relay, battery 140 volts and arriving current 13 milliamperes. The maximum speed of the Wheatstone (Morse alphabet) was 25 words per minute. The Murray system (Baudot alphabet) under exactly the same conditions got 63 words per minute easily and perfectly. Ten messages were transmitted and printed without an error.

On March 9th, 1906, a trial of the Murray system was made from Berlin to St. Petersburg direct without a repeater. The length of this line is about 1,080 miles (1,728 kilometres). From St. Petersburg to Eydtkuhnen, on the German frontier, the line consists of 600 miles of 5 mm. iron wire, and from Eydtkuhnen to Berlin 480 miles of 3 mm. copper wire (4·37 ohms per mile). The total resistance of the line was 7,425 ohms. The trial was from 8.30 to 9.30 a.m., Berlin time. Berlin tested the wire, and reported that it was "not clean" (nicht rein), and wet snow was falling in St. Petersburg, where there was a thaw. After a few experiments a speed of 70 words per minute was reached perfectly with the Murray system on this line, the German typewriter sentence containing all the letters of the alphabet, "Kaufen Sie jede Woche vier gute bequeme Pelze xy 1234567890" being transmitted and received over and over again perfectly for about 10 minutes. Traffic requirements did not permit of further experiments, but it is probable that by the use of a shunted condenser and increased battery power the speed might have been raised up to 80 or 90 words per minute. The highly favourable results obtained with the Murray system during these trials are explained by the inventor as being chiefly due to the employment of the Baudot alphabet, which is shorter than the Morse in the ratio of five to eight. It may also be mentioned that the inductive interference from neighbouring wires was very severe on these long lines, and was an important factor in limiting the speeds obtained. The Wheatstone apparatus was well adjusted by skilful mechanics, and the results were as good as could be expected from it under the conditions. Special artifices, such as shunted condensers, were not employed.

Mr. Murray adds that whatever truth there may be in the newspaper reports about other departments of the Russian Government, the Russian Telegraph Service appears to be efficiently managed. Both in St. Petersburg and Moscow he found the head telegraph offices up-to-date and well equipped and arranged, and the officials hard-working, capable and well instructed. The volume of messages handled in Russia is far less than in Great Britain, about 20 millions, as against 90 millions per annum; but on the other hand, the territory served by the Russian telegraphs is vastly greater, and the enormous Russian distances and the arctic winters have introduced special technical difficulties which have been surmounted in a way that would do credit even to American telegraphic enterprise. There is a general demand on the part of the public for an extension of postal and telegraphic facilities, and there are hopes that the newly elected Gosudarstvennaia Duma, or Imperial Parliament, will recommend the appropriation of sufficient funds to enable these increased facilities to be provided. Meanwhile, the Russian post and telegraph department has made the best use of the means at its disposal, and succeeds in bringing in a very large annual profit to the State.

For working over moderate distances the Hughes is employed, and nearly all the long-distance circuits are equipped with the Wheatstone automatic, the received tape being handed to typewriter girls for transcription, a considerable number of typewriters being used for this purpose both in the St. Petersburg and Moscow telegraph offices. Nearly all the telegraph wires are 5-millimetre iron (about 600 lb. per mile), and this fact, combined with the colossal distances, renders the use of an automatic system such as the Wheatstone inevitable. There are about 16 Wheatstone circuits in Russia, amongst others Petersburg to Rostov, 1,100 miles and two repeaters; Kazan to Omsk, 1,000 miles and one repeater; Omsk to Irkutsk, 1,200 miles and two repeaters; St. Petersburg to Odessa, 1,000 miles and two repeaters. From Irkutsk to Vladivostok is about 1,800 miles, and from St. Petersburg to Vladivostok is roughly about 5,000 miles. The longest Wheatstone circuit in Russia is the special wire from St. Petersburg to Irkutsk on Lake Baikal. This is 6-millimetre iron wire (about 800 lb. per mile), and the length of the circuit is about 3,800 miles with six repeating stations. Pekin is, roughly, about 1,000 miles from Irkutsk, and on one occasion the experiment was made of working through direct from St. Petersburg to Pekin. A speed of 30 words a minute was reached quite clearly; a noteworthy achievement, considering that the line consists of over 4,500 miles of iron wire.

When Mr. Murray arrived in Russia the great postal and telegraph strike was over, and normal conditions had been re-established, but in Moscow the telegraph department was still hampered to some extent by the destruction of its city wires during the riots last year. The strikers tore down the telegraph lines in all directions, and in various quarters of the city telegraph poles could be seen with a tangle of wires still clinging to them. The inconvenience caused by the destruction of the Moscow wires was serious, because Moscow is a great telegraph centre from which wires radiate all over Russia. Temporary lines have been erected, but the Government is not going to be caught again in this way, and arrangements are being made for putting city wires underground in cables.

The Murray automatic printing telegraph system has now been working for about two years between Edinburgh and London, and a complete duplex installation is being constructed for London—Dublin. The system has also been working for more than a year between Hamburg and Berlin, and it is now working between St. Petersburg and Moscow. The Indian Telegraph Department has ordered a complete duplex equipment for use between Calcutta and Bombay, a distance of 1,200 miles, and the Austrian Administration is having an experimental set constructed for trial between Vienna and Prague. When sets have been installed between London and Berlin, and between Berlin and St. Petersburg, it will be possible (owing to the power of re-transmitting messages automatically from the received Murray tape) for any of the cities, Edinburgh, Dublin, London, Berlin, Hamburg, St. Petersburg and Moscow (and by-and-bye Vienna) to exchange telegrams with each other automatically without disturbing the local traffic between any two of these cities.

NEW PATENTS APPLIED FOR.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

8,423. "Improvements in or connected with motor starting switches." J. Vickers. April 7th.

9,035. "An improved electric arc lamp." T. H. Large. April 17th.

9,068. "Improvements in selective signalling apparatus." W. Fairweather. (International Telegraphic Call Co., United States.) April 17th. (Complete.)

9,086. "Improvements in and relating to induction electrical machines." H. Wommelsdorf. April 17th. (Complete.)

9,089. "Improvements in or relating to X-ray apparatus." M. Levy. April 17th. (Complete.)

9,090. "Improvements in dynamo electric machines." H. Chitty. April 17th.

9,109. "An improvement in electric incandescence lamps." Siemens and Halske Aktiengesellschaft. (Date applied for under Patents Act, 1901, May 17th, 1905, being date of application in Germany.) April 17th. (Complete.)

9,112. "Improvements in and relating to electric motor control systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 17th.

9,115. "Improvements in telegraph poles." R. B. Ransford. (B. Bayly, South Africa.) April 17th.

9,117. "Improvements in and relating to magneto electric generators." Ateliers Thomson-Houston. (Anciens Etablissements Postel Vinay). Date applied for under Patents Act, 1901, April 17th, 1905, being date of application in France.) April 17th. (Complete.)

9,122. "Improvements in or relating to starting mechanism for explosion and other engines." E. Cantono. April 17th. (Complete.)

9,142. "A new or improved electrical wire conduit surface outlet box." The Aberdeen Electrical Engineering Co., Ltd., and R. G. Botting. April 18th.

9,146. "A terminal attachment for conveniently connecting up, or releasing, a wire conductor." W. M. Hall. April 18th.

9,164. "Improvements in electric furnaces for treating gases by means of electro-magnetically or electro-dynamically actuated electric arcs." A. J. Petersson. (Date applied for under Patents Act, 1901, April 18th, 1905, being date of application in Sweden.) April 18th. (Complete.)

9,186. "Improvements in electric bells. C. H. North. (Date applied for under Patents Act, 1901, April 22nd, 1905, being date of application in United States.) April 18th. (Complete.)

9,191. "Improvements in apparatus for automatically operating electric switches at any given intervals." M. W. W. Mackie. April 18th.

9,203. "Improvements relating to electric ignition gear for explosion engines." L. A. Gianoli. (Date applied for under Patents Act, 1901, April 20th, 1905, being date of application in Belginm.) April 18th. (Complete.)

9,294. "Improvements in dynamos for railway train lighting." H. Leitner. April 18th.

9,209. "Improvements in apparatus for intensifying electrical oscillations." C. Hochenegg. April 18th.

9,225. "Automatic electric tell-tale apparatus for automobile or other oil or gas lamps." F. Collins and C. E. Price. April 19th.

9,227. "Improvements in fuse boxes." A. Eckstein and A. C. Heap. April 19th.

9,234. "Improvements in magneto-electric ignition apparatus for use in connection with internal combustion motors, guns and the like." T. Bergmann. April 19th. (Complete.)

9,244. "Improved electric irons." H. J. Read. April 19th.

9,245. "Electric kettles and water boilers." H. J. Read. April 19th.

9,253. "Improvements relating to vapour electric apparatus." P. C. Hewitt. (Date applied for under Patents Act, 1901, April 28th, 1905, being date of application in United States.) April 19th. (Complete.)

9,256. "Improved sparking plug for internal combustion engines." N. W. H. Sharpe. April 19th.

9,268. "Improved electro-magnetic governor." D. Bacon. April 19th. (Complete.)

9,271. "Improvements in or connected with adaptors for incandescent electric lamps." G. M. Boddy. (Phillips & Co., Holland.) April 19th.

9,273. "Improved means for reducing the reflex action at the points of connection of electrical conductors or circuits differing in the values of their electrical properties." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt-Ges, Germany.) April 19th. (Complete.)

9,276. "Improvements relating to indication of current leakage in electric motors." H. McGillivray. April 19th.

9,279. "Improvements in the production of long stable electric arcs." J. Y. Johnson. (Badische Anilin and Soda Fabrik, Germany). April 19th.

9,284. "Improvements in incandescent electric lamps." H. Leitner. April 19th.

9,289. "Improvements in the electro-deposition of metals." E. Casper. April 19th.

9,313. "Improvements relating to the automatic regulation of continuous current electromotors used for driving variably or intermittently working machines, such as rolling mills and the like." H. Pieper. April 20th. (Complete.)

9,328. "Improved electric ship log and indicator." E. V. H. Rizzo. April 20th.

9,330. "Improvements in electrical measuring instruments." E. F. Moy, P. H. Bastie and E. F. Moy, Ltd. April 20th.

9,341. "Improvements in or relating to devices for supporting the line wires of electric railways or tramways." C. de Kando. April 20th. (Complete.)

9,343. "Improvements in electric arc lamps." J. Brockie. April 20th.

9,346. "Improvements in pocket electric lamps." P. M. Justice. (Deutsche Gasgluhlicht Akt.-Ges. (Augrges), Germany.) April 20th. (Complete.)

9,347. "Improved construction of accumulators or secondary batteries." A. E. Dakhyl, A. Galanti and H. N. Dakhyl. April 20th.

9,348. "Improvements relating to switches for use with the transmitters and receivers of electrical signalling apparatus." A. T. Dawson and G. T. Buckham. April 20th.

9,349. "Improvements in and relating to the manufacture of cement joints for incandescent electric lamp filaments." A. Just, F. Hanaman, H. Landesberger, O. Salzman and Vereinigte Elektricitats Akt.-Ges. April 20th.

9,351. "An improvement in galvanometers." J. Richard. April 20th.

9,357. "Improved method and apparatus for neutralising deflecting forces acting on a magnet or system of magnets." H. Gercke. April 20th. (Complete.)

9,383. "Improvements in or relating to electric ignition for internal combustion engines." J. A. Dixon and A. Speight. April 21st.

9,393. "Electroplating apparatus." A. W. L. Hommedieu. (Date applied for under Patents Act, 1901, April 22nd, 1905, being date of application in United States.) April 21st. (Complete.)

9,410. "Improvements relating to electric bells and installations for working the same." W. Knight. April 21st.

9,411. "An improved method of generating electricity and apparatus therefor." J. de Torley and S. Benko. April 21st.

9,412. "Improvements in space telegraphy." J. S. Stone. (Date applied for under Patents Act, 1901, May 4th, 1905, being date of application in United States.) April 21st. (Complete.)

9,415. "Improvements in and relating to signalling apparatus." The British Thomson-Houston Co., Ltd, (The General Electric Co., United States.) April 21st.

9,417. "Improvements in space telegraphy." J. S. Stone. (Date applied for under Patents Act, 1901, May 4th, 1905, being date of application in United States.) April 21st. (Complete.)

9,420. "Improvements in and relating to arc lamps." E. R. Grotz and M. V. Ely. April 21st.

9,422. "Improvements in space telegraphy." J. S. Stone. (Date applied for under Patents Act, 1901, May 10th, 1905, being date of application in United States.) April 21st. (Complete.)

9,425. "Improvements in apparatus for the manufacture of iron tubes by electro-deposition." S. O. Cowper-Coles. April 21st.

9,435. "An improved process of treating sheet metal and depositing metallic coatings thereon by electrolysis." Hille & Muller. April 21st.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

Telegraph Transmitting Instruments. F. H. W. Higgins. 28,268. December 23rd.

1905.

Apparatus for Automatically Recording the Number of Times a Telephone is Used. R. Richmond and G. E. Clark. 12,618. June 19th.

Electric Arc Lamps. British Thomson-Houston Co., Ltd. (General Electric Co.) 12,964. June 22nd.

Dynamo-Electric Machines. W. A. Johnson. 13,163. June 26th.

Electric Switch. G. L. Hertz. 14,978. July 20th. (Date applied for under International Convention, October 7th, 1904.)

Sparking Plugs for Internal Combustion Engines and the like. A. E. Lamkin. 15,880. August 3rd.

Rheostats, Controllers and Starting Switches for Electromotors. J. R. Craig. 16,063. August 5th.

Electric Cells or Galvanic Batteries. H. Stern and G. Engisch. 17,402. August 28th.

Step-by-Step Electric Switches Especially Applicable as Line Selectors. I. B. Birnbaum and H. G. White. 17,957. September 5th.

Receivers for the Wireless Transmission of Signals. V. Poulsen. 18,087. September 6th. (Date applied for under International Convention, September 17th, 1904.)

Electrodes for Use in the Manufacture of Bleaching Liquor. R. Kother. 21,437. October 21st.

Locking Device and Electric Coupling for Arc Lamps and the like. J. H. Bastians. 23,878. November 20th. (Date applied for under International Convention, January 6th, 1905.)

Electric Cables. The Land und Seekabelwerke Akt.-Ges. 25,058. December 2nd. (Date applied for under International Convention, December 2nd, 1904.)

Device for Limiting the Speed of Compensated Series Alternating Current Electromotors. Elektrizitats Act.-Ges. vorm W. Lahmeyer & Co. 25,393. December 6th. (Date applied for under International Convention, December 27th, 1904.)

Arc Lamps. H. M. Körting. 26,086. December 14th.

Ignition Devices for Explosion Motors. H. L. Maillard. 2,694. February 9th. (Date applied for under International Convention, April 7th, 1904.)

Sparking Plugs for Internal Combustion Engines. H. L. Maillard. 2,695. February 9th. (Date applied for under International Convention, December 8th, 1904.)

Alternating Current Electric Motors. Union Elektricitäts-Ges. in liquidation. 4,845. March 8th. (Date applied for under International Convention, March 12th, 1904.)

Electrically Driven Steering Gear for Ships and the like. W. H. Harfield and W. Routledge. 5,143. March 11th.

Hermetically Sealing Electrical Conductors into Glass. C. O. Bastian. 5,357. March 14th.

Telegraphic Apparatus. F. G. Creed and W. A. Coulson. 5,490. March 16th.

Electric Signalling for Railways and Controlling Equipment and Track Construction Therefor. G. Thompson and H. W. Merchant. 5,662. March 17th.

Electric Motors. Mather & Platt, Ltd., and E. Hopkinson, and J. Frith. 5,899. March 21st.

Dynamo-Electric Machines. British Thomson-Houston Co., Ltd. (General Electric Co.) 5,983. March 21st.

Magneto-Electric Generators. T. W. S. Hutchins. 6,089. March 23rd.

Process or Apparatus for the Electrical Production of Cast-Iron. Soc. Electro-Metallurgique Francaise. 6,468. March 27th. (Date applied for under International Convention, March 25th, 1904.)

Method or Arrangement for Preventing Accident and Loss of Life Through the Breakage of Overhead Electric Tramcar Wires. G. W. Fowler and G. Hildreth. 6,904. April 1st.

Electric Motor Control Systems Applicable for Electrically Propelled Trams or Vehicles. British Thomson-Houston Co., Ltd. (General Elec. Co.) 7,148. April 4th.

Apparatus for Supplying or Distributing Alternating Electric Currents. A. F. Berry. 7,596. April 10th.

Manufacture of Electric Accumulators. H. Leitner. 7,720. April 11th.

Electric Motor Controlling Switches. British Thomson-Houston Co., Ltd. (General Electric Co.) 8,028. April 14th.

Trolley Poles of Electric Tramcars. J. S. Dronsfield and C. J. J. Huntley. 10,446. May 18th.

Coin-Freed Electricity Meters. J. M. Tourtel. 10,509. May 19th.

Electric Advertising Signs. L. K. Job. 10,609. May 20th.

Switching Devices Applicable to Electric Flash Advertising Signs. L. K. Job. 10,610. May 20th.

Electric Cables. W. Bacon. 11,470. June 1st.

Electric Potential Indicators. British Thomson-Houston Co., Ltd. (General Electric Co.) 13,976. July 6th.

Electrical Distribution or Junction Boxes. R. S. Downe and J. S. Black. 14,013. July 6th.

Coin-Freed Apparatus for the Supply of Electric Current. J. Hikeley and the Newcastle-upon-Tyne Electric Supply Co., Ltd. 15,969. August 4th.

Apparatus for Purification of Water by Electrical Means. J. F. Lester. 18,427. September 12th.

Arrangement of Relay and Fusible Cut-Out for Protecting Electric Circuits. G. Rebora. 19,285. September 23rd. (Date applied for under International Convention, September 23rd, 1904.)

Supports and Safety Devices for Overhead Electric Conductors. E. Giraud. 20,687. October 12th. (Date applied for under International Convention, October 31st, 1904.)

Electro-Plating Vats. F. E. Bagnall. 22,901. November 8th.

Time Mechanism for Controlling the Supply of Gas, Electricity and other Agents. A. Horstmann, S. A. Horstmann, G. O. H. Horstmann, E. H. Horstmann and W. T. Eedgar. 27,290. December 30th.

Electric Conveyor Systems. British Thomson-Houston Co., Ltd. (General Electric Co.) 5,584. March 16th.

Contact Maker for Electrical Ignition Devices and like Uses. G. W. Brindley, S. J. Bale and S. J. Murphy. 5,829. March 20th.

Apparatus for Electric Telegraphs. Siemens Bros. & Co., Ltd., and G. S. Grimston. 6,557. March 28th.

Time Controlled Electric Switches. H. C. Little. 6,567. March 28th.

Safety Devices for Overhead Wires for Electric Traction and other Purposes. H. R. Burnett. 6,958. April 3rd.

Generation of Electricity by Means of Earth Cells. E. Jahr. 7,006. April 3rd.

Electrically Driven Vehicles. British Thomson-Houston Co., Ltd. (General Electric Co.) 7,421. April 7th.

Railway and the like Signals and Mechanism Therefor. British Thomson-Houston Co., Ltd. (General Electric Co.) 7,422. April 7th.

Systems of Control for Electric Motors and Apparatus Therefor. British Thomson-Houston Co., Ltd. (General Electric Co.) 7,822. April 12th.

Block Signal Systems for Railways. British Thomson-Houston Co., Ltd. (General Electric Co.) 8,027. April 14th.

Machines for Use in the Manufacture of Incandescent Electric Lamps. British Thomson-Houston Co., Ltd. (General Electric Co.) 8,568. April 20th.

Electric Light Candle Fitting. H. Hirst and J. H. Collings. 9,181. May 2nd.

Regulation of Electric Circuits Subject to Rapidly Fluctuating Loads. W. Armistead and M. J. E. Tilney. 9,940. May 11th.

Supporting and Insulating the Live Conductor Rail of Electric Traction Systems. C. H. Roberts. 12,023. June 8th.

Metallic Vapour Electric Lamps. F. Harrison. 12,337. June 14th.

Device for Testing or Detecting Electrical Sparking. F. E. Smith. 13,346. June 28th.

Electricity Meters. S. H. Holden and Chamberlain & Hookham, Ltd. 14,511. July 14th.

Electric Arc Lamps. Crompton & Co., Ltd., and A. J. Hodgson. 14,615. July 15th.

Insulated Bolts for Electric Tramway Systems and the like. J. Haydock and T. S. Jones. 19,753. September 30th.

1906.

Electric Signalling Apparatus. Siemens Bros. & Co., Ltd. (Siemens and Halske Akt.-Ges.) 378. January 5th.

Certain Parts of Electric Switches. Veritys, Ltd., and A. E. Gott. 1,242. January 17th.

Electric Switches. C. A. Allison. (Empire Electric Stage Lighting Co. Incorporated.) 1,738. January 23rd.